

SCIENCE ABSTRACTS.

Section A.—PHYSICS.

OCTOBER, 1932.

GENERAL PHYSICS.

3515. Direct-Reading Electrical Chronograph for Very Short Time-Intervals. R. Dubois and L. Laboureur. *Comptes Rendus*, 194. pp. 1639-1641, May 9, 1932.—This apparatus is based on the use of a triode valve as an electrometer, but the paper is so detailed as to require consulting in its entirety. H. H. Ho.

3516. Gravity Measurements by the Holweck-Lejay Apparatus. P. Lejay and R. Goudey. *Comptes Rendus*, 194. pp. 1632-1633, May 9, 1932.—By means of the apparatus already described [see Abstract 2902 (1931)], the ratio $R = 2T/T'$ is evaluated, where T is the period of the free and T' that of the gravity pendulum, from which g is calculated from the formula: $g = 980.941$ cm. — 177.32 cm. ($R - 1.00362$). Tables of data are given for a number of stations. H. H. Ho.

3517. Gravity in North America and Western Europe. F. Ackerl. *Gerlands Beitr. z. Geophys.* 36. 2-3. pp. 155-170, 1932. *In German*.—At the same latitude in North America, gravity is less than in Europe. Results are compared for several parallels between 30° and 50° . Using the method of Prey, results are reduced to their values at sea-level, but no conclusion can be drawn as to the isostatic or non-isostatic distribution of masses in the earth's crust. H. M. B.

3518. Modernisation of Sterneck Pendulum Apparatus for Relative Gravity Determinations. K. Wold. *Gerlands Beitr. z. Geophys.* 36. 2-3. pp. 269-274, 1932. *In English*.—Using the apparatus modernised by Jelstrup [see following Abstract], a typical example is described to show the method of calculation of gravity and the accuracy which may be obtained. The apparatus can be easily transported and quickly fixed up in any field station and only one day is required to obtain satisfactory results in a single place. H. M. B.

3519. Converted Sterneck Pendulum Apparatus. G. Jelstrup. *Gerlands Beitr. z. Geophys.* 36. 2-3. pp. 275-279, 1932. *In English*.—The apparatus used in recent surveys in Norway [see preceding Abstract] is still the old Sterneck, bronze pendulum oscillating on an agate knife edge on an agate plate. The damping is reduced by enclosing it in an evacuated chamber, constant temperature is maintained by a thermostat, the personal equation is eliminated by using a photoelectric cell to record the oscillations and the exact timing is obtained by a long-wave radio receiver tuned to the rhythmic time signals from Lafayette, Rugby or Nauen. H. M. B.

3520. Surface Tension Measurements of Solutions of Dyes and of Silver Sols. T. Ruemele. *Zeits. f. phys. Chem.* 160. *Abt.A.* 1-2. pp. 8-14, May, 1932.—The bubble-pressure method of measurement is employed, using a quartz capillary (to avoid possibility of solution in surrounding liquid) directed upwards (to facilitate liberation of the bubble). The surface tension of a number of solutions of dyes was investigated both in the presence and in the absence of electrolytes, and the results considered in relation to the colloidal properties of the solutions. Lyophobic colloids have a surface tension practically equal to that of water, and the dyes are precipitated by traces of electrolytes, while lyophilic colloids cause a marked decrease in surface tension and are relatively stable to electrolytes. Solutions of KCl, KBr and KI exert similar effects and the slight differences noticed are attributed to secondary factors. Experiments with silver sols show various types of behaviour according to the mode of preparation of the sol, but the surface tension of the sols is shown to be a useful index of their colloidal state. L. V. C.

3521. Capillary Activity of Normal Aliphatic Dicarboxylic Acids. B. Tamamushi. *Chem. Soc. Japan, Bull.* 7. pp. 168-176, May, 1932. *In German.*—Surface tension measurements are given for aqueous solutions of the normal aliphatic dicarboxylic acids (oxalic, malonic, succinic, glutaric, adipic, pimelic, suberic, azelaic) in the concentration range 0-0.5 mol. per litre. The relation between surface tension decrease and concentration is linear, viz., $(\sigma_M - \sigma_L)/\sigma_M = KC$, where σ_M and σ_L are the surface tensions of the solvent and solution respectively, C is the concentration and K the specific capillary activity of the acid. For K the order is: oxalic < succinic < glutaric < malonic < adipic < azelaic < suberic. The Traube rule is valid for acids with an even number of carbon atoms. The work required to bring a molecule of the acid from the surface into the solution increases by 1240 cal. per $2 \times \text{CH}_2$. The adsorption of these acids by charcoal has also been investigated and the relative amounts adsorbed are: succinic < glutaric < malonic < adipic < azelaic < suberic. The Freundlich isotherm is valid throughout. The abnormalities connected with malonic and glutaric acids are discussed. H. H. Ho.

3522. Measurement of the Frictional Couple of a Shaft in its Bearings. M. Delfosse and R. Swyngedauw. *Comptes Rendus*, 194. pp. 1792-1794, May 23, 1932.—The rotation of a shaft in its bearings is brought about by an auxiliary electrically-driven shaft attached to it in a suitable manner by a good steel stay. In motion, the angle of torsion is measured by a system of electrical contacts on the two shafts. At rest, when contact is made by two brushes touching discs on the ends of the shafts a current flows and a galvanometer is deflected. When the shafts are rotated, no deflection is seen until one of the brushes is moved to make simultaneous contact with that of the other brush. The angle of torsion is measured by an attached vernier. H. M. B.

3523. Coefficient of Viscosity of Liquid Sodium Amalgam. G. R. Paranjpe. *Indian Journ. Phys.* 7. pp. 95-97, April 1, 1932.—The viscosity of liquid sodium amalgam decreases with time. The initial value is regained by mechanical agitation. F. J. W.

3524. Coefficient of Viscosity of Sulphur Dioxide over a Low Temperature Range. W. W. Stewart and O. Maass. *Canad. J. of Research*, 6. pp. 453-457, May, 1932.—The coefficient of viscosity of VOL. XXXV.—A.—1932.

sulphur dioxide has been measured over a temperature range from 30° to -75° C. The method and apparatus used are similar to those described by Sutherland and Maass [see Abstract 3081 (1932)]. All values for the viscosity are referred to air at 23° C. The measured values for the viscosity between 0° and 30° C. agree within the experimental error, about 0.1 %, with the values published by Trautz and his co-workers. At temperatures below 0° C. the values obtained for the viscosity are important, as they supply data on the viscosity of sulphur dioxide which heretofore have not been available in the literature. AUTHORS.

3525. Anomalous Viscosities of Gelatin Solutions. M. Pichot. *J. de Physique et le Radium*, 3. pp. 205-218, May, 1932.—A theoretical investigation and an experimental method are described for the study of the viscosity of colloidal solutions, the coefficients of viscosity and structure being determined by a graphical method. These coefficients are found to be functions of the concentration, temperature and history of the solution. A gelatin solution maintained at a constant temperature above a certain value θ obeys Poiseuille's law and the coefficient of viscosity increases with time, tending rapidly towards a constant value. The decomposition of the liquid is marked by a diminution of the coefficient of viscosity which becomes a decreasing function of time. At a constant temperature lower than θ , the gelatin solution exhibits viscosity anomalies. For solutions sufficiently removed from coagulation, a theoretical explanation is proposed. The coefficients of viscosity and structure are now increasing functions of the time up to the moment when decomposition commences. H. H. Ho.

3526. Viscosity and Flow-Tenacity (Fliessfestigkeit) of Viscous Mineral Oils. A. Gemant. *Preuss. Akad. Wiss. Berlin, Ber.* 14. pp. 168-181, 1932.—A U-tube form of apparatus is described, employing a tube a few mm. in diameter, for the determination of the viscosity η and the elasticity or flow-tenacity f of mineral oils at various temperatures. The total force acting upon the oil in viscous flow is given by $K = f + \eta dv/dr$, so that, if elastic forces are present, the pressure-velocity curves will not pass through the origin of coordinates. Two determinations of the velocity of flow at different pressure gradients are sufficient for the determination of f and η . The theory of the method is given, and experimental results relating to various mineral oils, some of which show the presence of elastic forces while others do not, are included. There appear to be two kinds of mineral lubricating oils: those in which flow is characterised by marked elastic forces which appear and increase rapidly as the temperature falls from about 50° C., and those in which no such elastic forces appear even at 0° C. Flow-tenacity is a property which is independent of the value of the viscosity of the oil. J. S. G. T.

3527. Laminar Movements of Viscous Incompressible Liquids. Part IV. A. Rosenblatt. *Accad. Lincei, Atti*, 15. pp. 553-558, April 3, 1932. *In French.*—Investigates the tensions and other forces acting within an incompressible viscous fluid. [For Part III, see Abstract 1473 (1932).] E. E. F. d'A.

3528. Motion of Elliptical Obstacle in a Slow Irrotational Current. A. Consiglio. *Accad. Lincei, Atti*, 15. pp. 724-729, May 1, 1932.—A mathematical investigation of the motion of an obstacle of elliptical profile and capable of rotation around its centre when placed in a current of perfect liquid. H. F. G.

3529. Waves of Permanent Type in Heterogeneous Liquids. L. Dubrell-Jacotin. *Accad. Lincei, Atti*, 15. pp. 814-819, May 15, 1932.

In French.—Confining his attention to the two-dimensional case when the motion is the same in parallel vertical planes the author establishes rigorously the following properties of waves in heterogeneous liquids. (1) For a liquid domain bounded by a horizontal and a curve l , a permanent motion in which l is displaced with constant velocity without alteration of form, is dynamically possible. (2) In an incompressible heterogeneous fluid, irrotational waves of permanent type cannot be propagated. Airy waves are obtainable, however, as in the homogeneous case. (3) Whatever the distribution of density, Gerstner waves represent a possible rigorous solution for a heterogeneous liquid of infinite depth. W. S. S.

3530. Variation of Resistance at Low Speeds under the Influence of Compressibility. B. Demtchenko. *Comptes Rendus*, 194. pp. 1720-1723, May 17, 1932.—Equations are derived for the resistance offered by

an obstacle to the flow of a compressible liquid and are applied to the case of (a) a rectangular plate placed in a liquid of infinite extent at an angle to the direction of flow, and (b) a plate placed normal to the direction of flow in a finite stream of liquid. H. F. G.

3531. Dirichlet Problems for an Annular Region, with Special Reference to Hydrodynamical Applications. S. Tomotika. *Phys. Math. Soc., Japan, Proc.* 14. pp. 197-213, May, 1932. *In English.*—Certain problems of Dirichlet for an annular region bounded by two concentric circles are discussed, making special reference to hydrodynamical applications at the same time, and, in each case, the expression is obtained in

terms of appropriate elliptic functions for an analytic function which satisfies the prescribed conditions. AUTHOR.

3532. Normal Derivatives of Harmonic Functions in the Dirichlet Problem. F. Vasilescu. *Comptes Rendus*, 194. pp. 1546-1549, May 2, 1932.—In continuation of previous work [see Abstract 1477 (1932)] the author derives expressions for the normal derivatives of the harmonic functions concerned in the hydrodynamical problem of Dirichlet, the analysis being limited to a plane. J. S. G. T.

3533. Application of Non-Linear Integral Equations in Theory of Turbulent Fluid Motion. J. Leray. *Comptes Rendus*, 194. pp. 1627-1629, May 9, 1932.—Non-linear integral equations of the type discussed by Schmidt (*Mathematische Annalen*, 1908, 65. p. 370) are briefly mentioned. Application of the theory to the turbulent motion of a plane of fluid enclosed within a fixed convex boundary to which the fluid adheres is suggested. J. S. G. T.

3534. Motion of Unbounded Liquids. J. Leray. *Comptes Rendus*, 194. pp. 1892-1894, May 30, 1932.—In continuation of previous work [see Abstract 1478 (1932)] the author discusses the three-dimensional motion of a viscous liquid, and the two-dimensional motion of a viscous or perfect liquid. J. S. G. T.

3535. Determination of the Pitot-Static Tube Factor at Low Reynolds Numbers, with Special Reference to the Measurement of Low Air Speeds. E. Ower and F. C. Johansen. *Roy. Soc., Proc.* 136. pp. 153-175, May 2, 1932.—Values of the pitot-static factor, K , in the equation $Kp = \rho v^2/2$, the symbols having their customary significance, VOL. XXXV.—A.—1932.

are determined for air speeds ranging from 1.6 to 23.8 ft. per sec., the pitot-tube being carried at the end of an arm rotating about an axis which was generally vertical. The following values of K were found at the respective velocities stated (ft. per sec.): 2, 0.980; 4, 1.011; 6, 1.005; 8, 1.008; 10, 1.009; 12, 1.008; 14, 1.005; 16, 1.002; 18, 1.001; 20, 1.000; 22, 0.999; 24, 0.999.

J. S. G. T.

3536. Speed Factor and Power Input of Diffusion Pumps. T. L. Ho. *Physics*, 2. pp. 386-395, May, 1932.—The speed factor of a diffusion pump is defined as the ratio of its real speed to the ideal maximum speed. The fact that the speed factor is much less than unity is due to three causes, namely, the vapour dispersed through the slit, the nozzle chamber resistance and the diffuse reflection of gas molecules at the boundary of the vapour-stream and at the condensing wall. Some effects on the speed are considered as being independent of the configuration. The following general conclusions result from the measurement of the speeds of different configurations: (a) In order to reduce the amount of dispersed vapour by the slit, the vapour nozzle should be divergent instead of being parallel; (b) in order to reduce the chamber resistance the space surrounding the slit should be large and the nozzle chamber should be cold; (c) there exists for each design a certain slit area at which the speed is maximum, but there has been no general rule to predetermine it; (d) in designing a large pump either a narrow-throat annular nozzle or multiple nozzles can be used.

AUTHOR.

3537. Oil-Diffusion Air Pump. W. Gaede. *Zeits. f. techn. Physik*, 13. 5. pp. 210-212, 1932.—Describes a new diffusion air-pump, in which the more volatile constituents of the oil used are separated and collected during the working of the pump. The working is improved by continued use.

A. D.

3538. Diffusion of Zinc in Copper and Its Alloys. Y. Yamauchi. *Kyoto Coll. Sci., Mem.* 15. pp. 67-95, March, 1932. *In English*.—Brass-coated iron or steel is free from surface-rust, etc. Iron or steel may be coated with brass, (1) by electroplating, (2) by metal spraying, (3) by the dip process, (4) by first coating the iron or steel with copper and then converting the latter into brass by zinc diffusion brought about by heating in zinc vapour. The author has studied the diffusion of zinc vapour into heated copper in a hydrogen atmosphere, with reference to time and temperature; also the loss of zinc from the surface of various brasses at various times and temperatures. Gives tables, empirical formulæ and microphotographs.

A. D.

3539. Influence of Temperature upon the Diffusion Velocity of Solid Metals. C. Matano. *Kyoto Coll. Sci., Mem.* 15. pp. 167-180, May, 1932. *In English*.—In the first part it is shown that the ratio of velocities of diffusion given by Weiss is equal to the ratio of coefficients of diffusion defined by Fick's law in the case of primary solid solutions. In the second part, the zinc-copper system being taken as an example, it is shown by means of an electrical resistance method that the velocity of diffusion can exist in the case of non-primary solid solutions and some of the states of diffusion have been examined by X-rays. In the third part it is proved that the relation between the velocity of diffusion V and the absolute temperature T is given by $V = Be^{-\frac{Q}{RT}}$ instead of by Weiss' formula

$V = Ke^{\alpha T}$ with the zinc-copper system in the range of temperature 87–302° C., where B , K , α and β are constants and $\alpha = 9.52 \times 10^3$ degrees.

AUTHOR

3540. Permeability to Gases of Refractory Material. F. Durau. *Zeits. f. techn. Physik*, 13. 5. pp. 228–232; *Disc.*, 232–233, 1932.—Permeability of standard best porcelain tubes to NaCl vapour is very small even at 1200° C.

A. D.

3541. Diffusion of Hydrogen through Palladium. V. Lombard and C. Eichner. *Comptes Rendus*, 194. pp. 1929–1931, May 30, 1932.—The present experiments relate to the diffusion of commercial electrolytic hydrogen through a palladium plate 0.314 mm. thick into a vacuum. The gas was under constant pressure (370 mm. mercury) at temperatures between 196° and 600° C., and also at constant temperature (372° C.) under pressures varying from atmospheric to 40 mm. mercury. Comparative experiments were also made with dried and purified hydrogen. The data are represented in the paper by curves showing the influence of temperature and pressure. Uniformity of diffusion is only slowly established around 278°, but rapidly above 400° C. Circumstances which alter the diffusing power of palladium are discussed. The formula $d = Kp^{0.8}$ ($K = \text{const.}$) appears to represent the influence of pressure. H. H. Ho.

3542. Apparatus for Long-Period Temperature-Stress Tests on Metals. W. H. Hatfield, G. Stanfield, J. Woolman and N. B. McGregor. *Journ. Sci. Instruments*, 9. pp. 150–152, May, 1932.—The paper describes an apparatus for high temperature mechanical testing suitable for accurate determination of "creep" and allied effects. The apparatus includes a sensitive extensometer and a method for very close control of the temperature of the specimen heated in an electric resistance furnace. The method makes use of a platinum resistance coil placed in the furnace, which forms part of a Wheatstone bridge, and through a control indicator and relay operates the adjustment of the furnace current to compensate for minor fluctuations. The forms of testing machine and layout are described, and the order of sensitivity indicated. AUTHORS.

3543. Tensile Strength of Thin Fibres. F. Seidl. *Zeits. f. Physik*, 75. 11–12. pp. 735–740, May 6, 1932.—If a quartz fibre is attached at one end to a piezoelectric quartz crystal, and at the other to a small iron mass which can be drawn into a solenoid, the breaking load may be determined with great accuracy from observations on the electric charge on the crystal. Applications to the testing of other thin fibres are discussed.

J. P. A.

3544. Elastic Limits of Extra-Mild Steel Wire. J. Gallibourg. *Comptes Rendus*, 194. pp. 1635–1637, May 9, 1932.—This work continues a previous investigation [see Abstract 2341 (1930)] and studies the effect of ageing on the elastic diagram for drawn steel at different temperatures.

H. H. Ho.

3545. Static Hysteresis and Flexural Stress. G. H. Keulegan. *Bureau of Standards, J. of Research*, 8. pp. 635–656, May, 1932.—Continuing previous work [see Abstract 2551 (1931)], static hysteresis in a U bar of Armco iron (in which elastic after-effect is negligible) is measured in the usual manner and compared with calculations from the observed rate of decay of transverse vibrations in the bar. Within the limits of the accuracy

of the approximate theory used, the methods gave equivalent results. For stresses above a small threshold value, the energy lost by statical hysteresis varied approximately as the cube of the amplitude of the maximum stress. For Armco iron, therefore, the more convenient dynamic method may be used. J. P. A.

3546. Problems of Elastic Vibration. V. Smirnoff and S. Soboleff. *Comptes Rendus*, 194. pp. 1797-1799, May 23, 1932.—A previous theoretical investigation [see Abstract 3099 (1932)] is continued. The theorem previously applied to a point source of longitudinal vibrations in a plane is now similarly applied to the general theory of a point source of transverse vibrations in a plane. J. P. A.

3547. Measurement of the Natural Frequency, Damping and Modulus of Elasticity of Walls. J. Weishaupt. *Zeits. f. techn. Physik*, 13. 6. pp. 286-288, 1932.—Two simple methods of obtaining the elastic constants of a wall are described. The influence of the air in a room on the natural frequency of the walls is examined, this gives an oscillation of high frequency (106 ~) which may be considered as a stationary plane-wave depending on the depth of the room. If there is a small opening at one side of the room, the natural frequency of its oscillation may be reckoned with great accuracy from the Helmholtz resonator formula.

H. M. B.

3548. Decay of Torsional Oscillation of an Iron Wire. Effect of Variation of Period. F. W. Alexander. *Phil. Mag.* 13. pp. 934-938, May, 1932.—In many cases the law of torsional oscillation of a wire can be represented by $y^n(x+a) = b$, where n , a and b are constants for any one experiment, y the range of oscillation and x the number of oscillations after torsion is applied and the wire left to itself. The length of the wire, the load on it, and the torsion are constant, but the moment of inertia, and so the period, are altered. Results show that n varies if the experiments are carried out at irregular intervals, but if the wire is put into the same physical state and the experiments performed on successive days, then no variation appears. H. M. B.

3549. Torsion of Cylinders of Symmetrical Section. W. J. Duncan. *Roy. Soc., Proc.* 136. pp. 95-113, May 2, 1932.—A solution of the St. Venant torsion problem is obtained by calculation from the equation to the boundary of the section, and is derived as an expansion in ascending powers of a "thickness parameter." In general, the coefficient of the n th power of this parameter cannot be given explicitly, but can be deduced by a process of successive derivation, and examples show that for sections whose fineness ratio is not less than about 5, a very few terms in the expansion are sufficient to determine the shearing stress function. A criterion which allows definite limits to be assigned to the error made in the approximation at any stage is established. Provided the boundary is smooth, the percentage error in the approximation tends to zero as the thickness is reduced. The case of a cubic oval resembling an aerofoil section is treated in detail. J. S. G. T.

3550. Empirical Rule for the Behaviour of Plastic Bodies towards Pressure. K. Przibram. *Akad. Wiss. Wien, Ber.* 141. 2a. 1-2. pp. 63-69, 1932.—With rock-salt, copper and, to a less marked extent, lead, there exists a region of pressure and thinness, within which the shortening
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(percentage diminution of thickness) of the specimen is expressed satisfactorily as a function of the pressure and degree of thinness by the formula $s = (bpx_0/d)/(1 + bpx_0/d)$, where x_0 is the initial thickness, d the length of the side of the square cross-section, p the pressure per sq. cm., and b a constant. With copper and lead for lesser degrees of thinness and for pressures above certain values, proportionality between shortening and pressure is observed [see Abstract 420 (1931)].

T. H. P.

3551. Solid Body Rolling on a Deformable Surface. C. Woronetz. *Comptes Rendus*, 194. pp. 1555-1557, May 2, 1932.—A statement of the differential equations of motion for a rigid body rolling without slip upon a deformable surface like that of wet sand, which does not recover immediately after the body has passed. Methods of approximate solution are mentioned.

J. P. A.

3552. Elastic and Plastic State of a Two-Dimensional Body Containing an Aperture. M. Davin. *Comptes Rendus*, 194. pp. 1557-1559, May 2, 1932.—In continuation of previous work [see Abstract 2249 (1932)] a statement and new approximate solution is obtained of the problem of the elastic and plastic states of a two-dimensional body containing a circular aperture, when the elastic limit is surpassed by an infinitesimal amount.

J. P. A.

3553. Elastic Properties of Rubber-Like Substances. K. H. Meyer, G. v. Susich and E. Valkö. *Kolloid Zeits.* 59. pp. 208-216, May, 1932.—The effects of temperature-variation and chemical treatment on the elastic properties of many different types of synthetic and natural complex organic substances are correlated with the characteristics of radiograms of these materials. The large reversible extension characteristic of rubber is found to be a widespread phenomenon, and depends upon the existence of a space lattice very long in the direction of extension. On the hypothesis that such lattices are formed on stretching the material, and that the energy of vibration of atoms in this direction is much smaller than that for a direction at right angles, a theory is given, accounting for the tendency to contract and for its temperature variation.

J. P. A.

3554. New Developments in Photoelasticity. A. G. Solakian. *J.O.S.A.* 22. pp. 293-306, May, 1932.—An account in English of H. Favre's work [see Abstract 20 (1930)].

J. P. A.

3555. Simple Method for the Numerical Solution of Differential Equations. W. G. Bickley. *Phil. Mag.* 13. pp. 1006-1014, May, 1932.—The method is based on the same principles as that due to Adam; given an equation $dy/dx = f(x+y)$, with initial conditions $y = y_0$ when $x = x_0$, integration gives $y - y_0 = \int_{x_0}^x f(xy)dx$, and the unknown values of y corresponding

to a set of values of x are found by successive approximation. Details of the method of making the approximations are given, together with an estimate of the accuracy, etc. It is claimed that the method is soundly based on Simpson's rule, and that the approximations are simple to make, and in a form suitable for the application of calculating machines. G. E. B.

3556. Univocal Theorem Relative to Poisson's Equation. A. Masotti. *Accad. Lincei, Atti*, 15. pp. 630-634, April 17, 1932.—Let S be a connected spacial field, whose periphery σ consists of one or more

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surfaces, at every point of which is determined the normal n , which is supposed directed towards the interior of the field. Assume a Cartesian orthogonal system of reference $O(x, y, z)$, and let $u(x, y, z)$ be a function which satisfies the following conditions: in the field and at its periphery it is a uniform function, finite and continuous, which has first derivatives finite and continuous; and has second derivatives finite and integrable in the field: if the field be infinite the function and its derivative in a generic direction r , at any point P of the field give the inequalities $\rho|u| < Q$,

$\rho^2 \left| \frac{du}{dr} \right| < Q$, ρ being the distance of the point P from a fixed point,

and Q a positive constant: in the field u satisfies Poisson's equation $\Delta_2 u = f(x, y, z)$: at the periphery, u and its normal derivative $v = du/dn$ are connected by a relation of the type $F(x, y, z, u, v) = 0$, or, upon different parts of the periphery, by relations of similar type: F is a function not necessarily continuous with respect to x, y, z , but differentiable with respect to u, v , and such that at every point of the periphery the derivatives dF/du and dF/dv cannot, for any values of u and v , be contemporaneously greater (or less) than zero, nor contemporaneously equal to zero except in points and lines of the periphery. The author shows that the function u is generally the only one which meets these conditions. A. D.

3557. Adiabatic Invariants as a Method for Approximately Solving Differential Equations. D. Graffi. *Accad. Lincei, Atti*, 15. pp. 657-663, April 17, 1932.—The author describes and discusses a general method for the use of adiabatic invariants in solving differential equations approximately, with special reference to the equation $\delta^2 q / \delta t^2 = -\omega^2 q$. A. D.

3558. Central Forces. V. Nobile. *Accad. Lincei, Atti*, 15. pp. 781-788, May 15, 1932.—Discusses the solution of the problem by Hatzidakis and Sakellariou of finding the most general law of central force depending on distance and velocity which gives for the trajectories the conics of the plane having a focus in the centre of attraction. Shows that the only force depending solely upon position is Newtonian gravitation, and that Kepler's third law is unnecessary for establishing it. There is, however, an infinity of central forces depending on distance and velocity which satisfy the problem, which includes Sakellariou's case. E. E. F. d'A.

3559. Linear Groups of Unitary Operators Related to the Motion of Dynamical Systems. E. Hopf. *Preuss. Akad. Wiss. Berlin, Ber.* 14. pp. 182-190, May, 1932.—The theory of unitary operators in Hilbertian space developed by Koopman [see Abstract 2301 (1932)] and by Weyl is applied to discuss the motion of dynamical systems. J. S. G. T.

3560. Crystal Structure of Beryllium Sulphate Tetrahydrate, $\text{BeSO}_4 \cdot 4\text{H}_2\text{O}$. C. A. Beevers and H. Lipson. *Zeits. f. Krist.* 82. pp. 297-308, May, 1932. *In English*.— $\text{BeSO}_4 \cdot 4\text{H}_2\text{O}$ is tetragonal, with $a : c = 1 : 0.946$. The structure consists of two sets of tetrahedral groups, one composed of SO_4 and the other of $4\text{H}_2\text{O}$ molecules surrounding a beryllium atom. The crystal class is probably D_{2d} and the space group D_{2d}^{10} . The suggested structure agrees with the absence of distinct cleavage. F. I. G. R.

3561. Crystallography of the Simpler Quinones. W. A. Caspari. *Roy. Soc., Proc.* 136. pp. 82-94, May 2, 1932.—The crystal habits and structures of the ortho- and para-quinones derived from benzene, naphthalene and anthracene are studied. The data obtained reveal no regularities

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or general characteristics of the quinones as a class; there is even no homology between naphthoquinone and anthraquinone such as exists between naphthalene and anthracene. The active points around the oxygen atoms appear to govern the mutual positions of the molecules and to render each substance of different structure. When the effect of these points is relatively great the tendency is towards unit cells containing few molecules, whereas large molecules with symmetrically distributed active points form multimolecular cells and, consequently, crystals of a higher degree of symmetry. The results are in accordance with an overall thickness and breadth of the benzene ring of 3.6 Å. and 5.5-6.0 Å., respectively, the lengths of the naphthalene and anthracene molecules being 8.0-8.7 Å. and 11.2-11.5 Å. respectively. H. F. G.

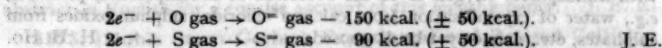
3562. Effects of Ionic Impurities on the Crystal-Habit of Potassium Chromate. H. E. Buckley. *Zeits. f. Krist.* 82. pp. 285-296, May, 1932. In English.— K_2CrO_4 and K_2SO_4 form mixed crystals, and are structurally much alike; yet morphologically they show great differences. The former shows {011} as the predominant form, and the latter {021}; it would seem that a difference between the SO_4 and CrO_4 ions must be responsible. The author studies effect of various "ionic" impurities (e.g., nitrate, chlorate, perchlorate, etc.) upon the habit of K_2CrO_4 . The Cr_2O_7 ion seems to be particularly powerful, and tends to increase the formation of {011}. F. I. G. R.

3563. Precision Measurements of Crystal Parameters. E. A. Owen and J. Iball. *Phil. Mag.* 13. pp. 1020-1028, May, 1932.—From powder photographs taken with precision cameras the lattice parameters of several metals having a cubic structure are measured. The metals examined are Al, Cu, Ag, Au, Ir, Pb, Mo, Ni, Pd, Rh, Ta and W. The results are given to four significant figures. J. T.

3564. X-Ray Investigation of Bi-Sb Alloys. E. G. Bowen and W. M. Jones. *Phil. Mag.* 13. pp. 1029-1032, May, 1932.—Homogeneous Bi-Sb alloys, obtained by very slow cooling from a temperature above the melting point of Bi, are examined by the powder method. A continuous series of solid solutions is found, the change of size of lattice edge with composition being almost linear over the whole range. J. T.

3565. Formation of Superlattices in Alloys of Iron and Aluminium. A. J. Bradley and A. H. Jay. *Roy. Soc., Proc.* 136. pp. 210-232, May 2, 1932.—A series of Fe-Al alloys containing 0 %-50 % Al (corresponding to the range Fe-FeAl) is examined by the powder method. Up to 18 % Al the structure is body-centred, Al atoms replacing Fe atoms at random. Above 18 % the structure depends on whether the alloys have been quenched or annealed. In the case of alloys quenched from above 600° C. the random distribution persists up to 25 % Al. Here there is a sudden change and, above 26 % Al, cube centres differ from cube corners. One set of positions is occupied by Fe atoms only, the other set contains both Fe and Al atoms. With annealed alloys an ordered state is gradually attained above 18 % Al, a new type of structure appearing. This is of the type Fe_3Al ; and the Al atoms lie on a face-centred cubic lattice forming a superlattice with dimensions twice as great as those of the small body-centred cube. From 40 % to 50 % Al these alloys have the FeAl type of structure like the quenched alloys in this range. J. T.

3566. Lattice Energy of Earth Alkali Oxides and Sulphides and Electron Energy of Oxygen and Sulphur. J. E. Mayer and Margaret McC. Maltbie. *Zeits. f. Physik*, 75. 11-12. pp. 748-762, May 6, 1932.—Born and Mayer [see Abstract 2717 (1932)] have recently given a new formula for the lattice energy, taking account of the van der Waals potential and null point energy. The formula is here applied to alkali earth oxides and sulphides. A table is given showing the lattice energies, heats of solution and the sum of these, which is equal to the energy change of solution of both ions in solution from the gas state at 0° K. to infinite dilution in water at 291° K. The difference of this last sum for oxide and sulphide of the same metal is the difference of heat of solution of O⁻ and S⁻ which should be constant with different crystals. The constancy obtained is fairly good. A second table shows the working out of the electron affinity. This gives as a mean:



3567. Molecular Process of Crystal Growth in Hexagonal Metals. Deposition upon Monocrystalline Hemispheres of Zinc. P. A. Anderson. *Phys. Rev.* 40. pp. 596-606, May 15, 1932.—The growth of a single crystal rod of zinc is allowed to proceed from a small orifice into a mass of molten zinc and the monocrystalline hemisphere thus formed isolated by rotation of the apparatus. The hemisphere is subjected to uniform bombardment by zinc vapour and observation of the growth on its surface forms the basis for a study of the variation of depositional rate with crystal surface structure. It is assumed, with Kossel and Stranski, that the force acting upon an atom which has struck the crystal surface is qualitatively proportional to the number of contiguous lattice atoms and a "force series" is drawn up listing the relative depositional energies for eleven typical positions of different crystal surface structure. With the aid of this force series the macroscopically observed growth on the experimental crystal is interpreted in terms of atom-by-atom deposition. AUTHOR.

3568. Growth and Solution of Crystals of Rock-Salt Type. I. N. Stranski. *Zeits. f. phys. Chem.* 17. Abt.B. 2-3. pp. 127-154, May, 1932.—A crystal face is called "complete" if the surface nets contain the greatest number of particles which are geometrically possible. Surfaces not satisfying this condition are called "incomplete." A "uniform" surface is one consisting of particles of equal size and similarly placed (without coinciding). Conversely for a "non-uniform" surface. A "recurrent" surface persists during growth of solution. Otherwise, surfaces are "non-recurrent." In rock-salt, the only "complete" surface is the cubic. F. I. G. R.

3569. Relation between the Temperature and Plasticity and Tensile Strength of Rock-Salt Crystals. W. Thelle. *Zeits. f. Physik*, 75. 11-12. pp. 763-776, May 6, 1932.—The curves of strengthening for small extensions, and the tensile strengths from room-temperature to 600° C. were determined for four different kinds of rock-salt, for tension perpendicular to a cube plane. Distortion and strengthening are not of an athermic character; in the temperature region investigated they are favoured by rise in temperature. The maximum strengthening obtained at 600° C. is 1000 times the stress at the commencement of plasticity.

The breaking strength of about 10,000 gm./mm.² corresponds to the strengths obtained for rock-salt dissolved under load (7000 to 12,000 gm./mm.²) and reaches, to within about one order of magnitude, the theoretical lattice strength of 200,000 to 400,000 gm./mm.². H. N. A.

3570. Tempering of Salt Crystals. E. Rexer. *Zeits. f. Physik*, 75, 11-12, pp. 777-783, May 6, 1932.—Thermal treatment of solid NaCl of whatever origin, i.e., rock-salt or prepared crystals, produces appreciable changes both in the surface layer and within the crystal which depend on the temperature, crystal magnitude and other factors. These changes, e.g., phosphorescence and alkalinity variation, are described in the paper, and appear to depend upon impurities in the material, but the phenomena cannot be completely removed by thermal treatment. Whether the differences between the surface layer and the interior are due to interaction with atmospheric oxygen or to the evolution of decomposition products, e.g., water of crystallisation from calcium chloride, sulphur oxides from sulphates, etc., cannot yet be diagnosed. H. H. Ho.

3571. Cohesion Limits and Orientation of Synthetic Potassium Halide Crystals. W. Schütze. *Zeits. f. Physik*, 76, 3-4, pp. 135-162, May 31, 1932.—The investigation of the properties of crystals prepared from the melts of KCl, KBr and KI, for tension perpendicular to a cube plane, gave a general confirmation of the known translator mechanism already arrived at for NaCl. With the potassium salts, however, with small tensions, four well-defined optical distortional steps are observed when polarised light is employed: local slip; first continuous slip planes; commencement of flow; marked flow. With the stronger deformations there is a non-crystallographic slip. The results are not as regular as in the case of NaCl, and no definite connection can be traced with the properties of the ions. It is shown that the law for the shear at the elastic limit is exactly followed for all tensions in directions situated in a cube plane, with KCl and KBr crystals prepared from the melted substances. With similar experimental rods the truth of the normal tension law for breaking follows from the proof that the statistical formation of groups from the limiting normal tensions is independent of the directions. For tension perpendicular to the octahedral plane the normal tension law is not confirmed, presumably because here there is a hindrance to normal deformation and hardening. The values of the cohesion limits are independent of the orientation of the side surfaces of the experimental rods. H. N. A.

3572. Anisotropic Liquids (Liquid Crystals) in the Electric Field. Part II. W. Kast. *Zeits. f. Physik*, 76, 1-2, pp. 19-23, May 12, 1932.—A series of differently treated preparations of *p*-azoxyanisole has been investigated at constant temperature and electrical field strength for displacement of the critical frequency; the X-ray diagram of the anisotropic melt exhibits no kind of orientation of the particles. The frequency displacement is found to be connected with contamination of the preparations by azoanisole. An influence due to electrical conductivity is not present. [See Abstract 4084 (1931).] H. H. Ho.

3573. Parachors and Chemical Constitution of Additive Compounds of Boron Trifluoride. S. Sugden and M. Waloff. *Chem. Soc., J.*, pp. 1492-1496, May, 1932.—The parachors of the additive compounds formed between BF₃ and methyl and ethyl formates and acetates, dimethyl

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and diethyl ethers, and methylacetanilide are recorded. The observed values are in close agreement with those calculated by taking the constant for B as 16.4 and that for F as 25.0. The Ramsay-Shields' coefficients indicate that all the compounds studied are normal liquids, with the exception of the methyl formate compound. The observed parachors afford no evidence in support of the view that two electrons more than the normal number are shared, and indicate that the hypothesis of a parachor defect due to an enlarged valency shell must be discarded.

H. F. G.

3574. Abundance of Elements and Isotopes and New Periodic Laws of Atomic Structure. R. A. Sonder. *Gerlands Beitr. z. Geophys.* 36, 2-3, pp. 319-378, 1932.—New regularities and periodicity laws relating to the elements and isotopes and their abundance, structural and other properties are described. Reference should be made to the published abstract in English for a concise account of this lengthy paper. J. E. K.

3575. Double Stern-Gerlach Experiment and Related Collision Phenomena. N. Rosen and C. Zener. *Phys. Rev.* 40, pp. 502-507, May 15, 1932.—The theory of the double Stern-Gerlach experiment is developed where the rate of rotation has a maximum at $t = 0$ and goes gradually to zero at $t = \pm \infty$. The negative results of the experiments of Phipps and Stern [see Abstract 1860 (1932)] are completely accounted for. The same analysis is applied to those collision phenomena where only two quantum states need be considered, and where their difference of energy, ΔE , is so much smaller than the relative kinetic energy of the two systems that the positions of the centres of gravity of the two systems may be regarded as time parameters. If $f(t) = 2\pi/\hbar$ times the matrix element of the perturbation, and if $A = \int_{-\infty}^{\infty} f(t) dt$, then the transition probability is

$$\left| \frac{\sin A}{A} \int_{-\infty}^{\infty} f(t) e^{2\pi i(\Delta E/\hbar)t} dt \right|^2$$

for the cases investigated, and this probably holds for all experimental cases.

AUTHORS.

3576. Atoms and Electrons. J. J. Thomson. *Manchester Phil. Soc., Mem.* 75, pp. 77-93, 1930-1931. *Dalton Lecture*.—After reviewing the development of the atomic theory, the theory of electrons and protons, and the notion of electron waves, the author describes his own theory, which is designed to explain, in particular, the quantitative relationship between mass and energy ($E = mc^2$) and the quantum equation ($E = h\nu$). The existence in space of so-called "granules," all of equal and minute mass μ and each carrying constant energy mc^2 , is postulated, and the masses of electrons, protons and photons are regarded as due entirely to the masses of the groups of granules associated with each of these "particles" by means of their electric fields. As the energy of the granules is the only energy recognised by the theory, the relation $E = mc^2$ follows at once as an exact result. For the law $E = h\nu$ a statistical interpretation is obtained by assuming the granules associated with a particle or material system to be subject to periodic collisions from outside granules. An upper limit for the value of μ is assessed, which comes out to be about $3/10^{10}$ of the mass of an electron.

W. S. S.

3577. Mass of the Electron. W. Duane. *Nat. Acad. Sci., Proc.* 18, pp. 319-322, April, 1932.—The mass of the electron may be estimated by means of a single experiment. In this estimate there are used Bragg's

formula, $\lambda = 2d \sin \theta$, for the reflection of X-rays by a crystal, and Bohr's formula for the Rydberg constant, $CR_{\infty} = 2\pi^2 e^4 \cdot m_0 / h^3$; and also Einstein's quantum equation, $Ve = hc/\lambda$, with $d = 3.028 \times 10^{-8}$ cm., measurement of V and θ gives $e^4/h = 5.689 \times 10^{13}$. We may accept $CR_{\infty} \leq 3.2899 \times 10^{15}$. This gives $m_0 = 9.054 \times 10^{-28}$. The value of e/m_0 appears (Perry and Chaffee) to be 1.7606×10^7 e.s.u.; this value gives $e \leq 1.5940 \times 10^{-20}$ e.m.u. or 4.779×10^{-10} e.s.u. From Campbell and Houston's more recent value for e/m_0 , $e = 4.771 \times 10^{-10}$ e.s.u.; and from Kirchner's value (1932), $e = 4.773 \times 10^{-10}$ e.s.u. and $h = 6.557 \times 10^{-27}$.
A. D.

3578. Electrons and Light Quanta. A. Fleming. *Phys. Soc., Proc.* 44. pp. 281-292; *Disc.*, 292-294, May 1, 1932.—The question whether electrons moving with or against a stream of photons are accelerated or retarded by the momentum of the latter—an effect which, if it exist, should be measurable in the case of strong sunlight or X-rays—has been investigated experimentally. Negative results only were obtained. The conclusion drawn is that either photons do not exist as defined mass particles during the transmission of light-energy or that the apparent area covered by photons in a beam of radiation or by electrons in an electronic current is very small compared with the cross-sectional area of the beam or current. In the *Discussion*, W. N. Bond suggested that the energy of the X-ray beam employed might very possibly be only about 1/10,000 of that estimated. L. Simons referred to the work of Hughes and Jauncey, which suggests that the cross-sectional area of a photon does not exceed 10^{-10} Å². D. Owen pointed out that the negative results of the experiments could be explained if fewer than 1 photon per 200 makes a head-on collision with an electron in the valve used. Moreover, "a complete atom is the simplest structure which can absorb a quantum of energy," so that the results obtained are necessarily negative.
J. S. G. T.

3579. Quantum Mechanics of Lithium Hydride. E. Hutchisson and M. Muskat. *Phys. Rev.* 40. pp. 340-344, May 1, 1932.—Quantum mechanical calculations have been carried through for the normal state of the lithium hydride molecule. Two cases were considered. First, the radial eigenfunction of the valence electron of lithium was taken as nodeless as given by Slater [see Abstract 3938 (1930)]. Second, the function derived by Guillemin and Zener [see Abstract 2744 (1930)] with a node at $0.18a_0$ was used. In both cases the K electrons of lithium were neglected. The results are as follows:

Type of Eigenfunction.	Equilibrium Distance. Å.	Heat of Dissociation (Electron Volts per Molecule).	Fundamental Frequency (cm. ⁻¹).
Slater	1.44	2.30	1.4×10^3
Guillemin and Zener	1.45	2.21	1.4×10^3
Experimental values	1.6	2.56	1.38×10^3

AUTHORS.

3580. Torsion Oscillator-Rotator in Quantum Mechanics. H. H. Nielsen. *Phys. Rev.* 40. pp. 445-456, May 1, 1932.—The author gives the quantum mechanics theory of a symmetric rotator which, besides the usual three degrees of rotational freedom, possesses one degree of
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torsional freedom, due to rotation of two of its principal parts about the axis of symmetry with an appropriate restoring torque. The Schrödinger equation proves to be separable into the quantum mechanics equation for an ordinary symmetric rotator and an equation of the form of Mathien's equation. The latter demands a general non-periodic solution which, however, degenerates into an exponential function when the restoring torque tends to zero. A qualitative discussion is given of the way in which the energy-states in the limiting case of zero restoring torque go over into the other limiting case of infinite restoring torque, and the calculation of intensities and selection rules is effected for the two limiting cases. These will probably hold approximately for very large and very small restoring torque. The practical interest of the problem is that certain molecules (e.g., C_2H_4 and C_2H_6) are thought to possess a structure resembling the torsion oscillator-rotator here discussed.

W. S. S.

3581. Relativistic Quantum Mechanics. P. A. M. Dirac. *Roy. Soc. Proc.* 136. pp. 453-464, May 2, 1932.—Attempts to treat the electromagnetic field as a dynamical system to which the usual methods of Hamiltonian quantum mechanics can be applied are invalid because the very nature of an observation of any system requires an interplay between the field and the "particles." A new method of attack is here developed which adopts the view that if an incident radiational field acts on a system, which as a consequence generates an outgoing radiational field, then the passage from the former field to the latter is simply a quantum jump of one field. For the case of a single electron acted upon by a radiational field the wave-equation is written with the electromagnetic potentials expanded into their Fourier components. The Fourier coefficients are now treated as operators satisfying quantum conditions appropriate to free space. The new wave-equation so obtained may be used as in the earlier theory to determine matrix elements associated with electron jumps. Each matrix element, however, will now also be associated with a quantum jump between two states of the electromagnetic field. When two particles are involved the wave-equation, involving the field potential operators, for each electron is written down, but no term is added for interaction energy as this is all taken care of by the field. The two wave-equations have then to be solved simultaneously. A detailed solution of a one-dimensional problem is given in order to show that forces of electrostatic character are implicitly contained in the theory.

W. S. S.

3582. Asymptotic Integration of the Thomas-Fermi Differential Equation. A. Sommerfeld. *Accad. Lincei, Atti*, 15. pp. 788-792, May 15, 1932.—The differential equation which, according to Fermi's statistics [Abstract 2261 (1928)] regulates the potential and the density of the electrons within an atom, has one exact solution, viz., $\frac{d^2\phi}{dx^2} = \frac{\phi^{3/2}}{\sqrt{x}}$ which satisfies the condition $\phi = 0$ for $x = \infty$, but not $\phi = 1$ for $x = 0$. In fact, the solution is only satisfactory for very high values of x . The author calculates a new asymptotic integration expressed in the formula

$$\phi = \frac{1}{(1+z)} |\lambda_1|/2, \quad z = \left(\frac{x}{12^{2/3}}\right)^{\lambda} \begin{cases} \lambda = 0.772 \\ |\lambda_1| = 7.772 \end{cases}$$

This integration was found in the first instance by the method of Emden's "gashugeln."

E. E. F. d'A.

3583. Physical Significance of Groups of Transformations. M. Mariani. *J. de Physique et le Radium*, 3. pp. 219-224, May, 1932.—In continuation of previous work [see Abstract 2316 (1932)] the author advances a simple physical interpretation of Bohr's complementary principle which suggests that natural laws are the characteristic invariants of a group of transformations enabling the observations to be compared amongst themselves. J. S. G. T.

3584. Principle of Conservation of Angular Momentum, or the Principle of Conservation of the Symmetry or Antisymmetry of the Total Wave Function (Bose or Fermi Statistics) in Molecules. B. Arakatsu and Y. Ota. *Faculty of Sci. and Agric., Taihoku, Imp. Univ. Mem.* 5. pp. 25-32, March, 1932. In English.—In collision processes, quite independent of the number of the angular momentum of the colliding particle (except the electron), the rotational motion of the molecule always obeys the selection rule $\Delta K = 0, \pm 2$. The molecule shows thus a disposition to retain its own nature of symmetry with respect to the coordinates of two nuclei in consequence of satisfying the principle of the conservation of the symmetry or antisymmetry of its total wave function with respect to the nuclei, i.e., being controlled by the statistics which hold in that molecule. J. E. K.

3585. Interpretation of Waves in Wave Mechanics. F. Prunier. *R.G.E.* 31. pp. 659-661, May 14, 1932.—The author shows that the theory developed in a previous paper [see Abstract 745 (1931)] leads to the conception of the waves characterising wave mechanics as two sets of longitudinal waves of unequal amplitudes. Expressions are derived for the group velocity, the acceleration of the wave field, and the Lorentz expression for the mechanical force acting on a charge moving in an electric field. J. S. G. T.

3586. Transmission and Reflection of Wave Packets by Potential Barriers. L. A. MacColl. *Phys. Rev.* 40. pp. 621-626, May 15, 1932.—In previous studies, by the methods of wave mechanics, of one-dimensional motion of particles in cases in which there are intervals in which the value of the potential energy function $V(x)$ exceeds the value of the total energy E , attention has been confined to wave functions of the form $f(x, E) \exp(-2\pi i E t / \hbar)$. In the present note wave packets are considered, instead of these trains of waves. The function $V(x)$ is taken as follows: $V(x) = 0$ for $x < 0$ and for $x > a$, $= V_0 > 0$ for $0 < x < a$. A wave function is set up which initially represents a wave packet moving toward the point $x = 0$ from the left. The separation of the incident packet into a reflected packet and a transmitted packet is studied. It is found that the transmitted packet appears at the point $x = a$ at about the time at which the incident packet reaches the point $x = 0$, so that there is no appreciable delay in the transmission of the packet through the barrier.

AUTHOR.

3587. Definition of Spatial Distance in General Relativity. H. S. Ruse. *Roy. Soc. Edinburgh, Proc.* 52. 2. pp. 183-194, 1932.—A definition of the concept of spatial distance, alternative to that given by Whittaker [see Abstract 347 (1932)], is discussed. The spatial distance, δ , between a star at the world-point (x^μ) and an observer at the world-point ($\bar{x}^\mu$), these points being on the same null geodesic, is given by $\delta = \partial \Omega / \partial \tau$, where Ω is half the square of the interval between x^μ and $\bar{x}^\mu$, τ is the

proper time of the observer at $\bar{x}$, and one of the variables may be eliminated by means of the equation $\Omega = 0$. The formula is compared with Whittaker's. J. S. G. T.

3588. Lorentz Contraction and Absolute Motion. M. la Rosa. *Accad. Lincei, Atti*, 15, pp. 502-505, April 3, 1932.—Controverses the contention of Courvoisier that he has found a genuine Lorentz contraction and an absolute velocity of the earth. E. E. F. d'A.

3589. Relativity in the Microcosm. Z. Pycha. *Accad. Lincei, Atti*, 15, pp. 820-827, May 15, 1932.—The unitary theories of Weyl, Eddington, Einstein and others, which attempt to explain gravitation and electricity in terms of a geometry of space-time, ignore the quantum character of atomic phenomena. In the geometrical scheme here developed (the "quantum chronotope"), with the object of including quantum effects, each point of the microcosmic chronotope is specified by four systems of numbers (of matrix character) which replace the ordinary scalar coordinates. Calculus rules are developed for working with these matrix coordinates and certain properties of the space so defined are derived. W. S. S.

3590. Relativity and the Uncertainty Principle. N. Rosen and M. S. Vallarta. *Phys. Rev.* 40, pp. 569-577, May 15, 1932.—The definition of simultaneity, based on the finite velocity of light, employed in the special relativity theory is taken as fundamental. It is then shown, by means of an ideal experiment consisting of the sending of a light signal, by an observer, to collide with an electron and return along its original track, that the uncertainty relations: $\Delta p \Delta x = \hbar$ and $\Delta E \Delta t = \hbar$, are possible in, but are not necessarily implied by, relativistic quantum mechanics. G. C. McV.

3591. Uncertainty Principle in Modern Physics. H. T. Flint. *Nature*, 129, pp. 746-747, May 21, 1932.—A sketch of a unitary theory of gravitation and quantum mechanics based on a five-dimensional geometry. A smallest detectable length and a smallest detectable interval of time can be associated with a moving particle, by means of this theory, giving rise to a generalised form of Heisenberg's uncertainty principle. A further deduction is that there must be a maximum atomic number, which is found to be 97. G. C. McV.

3592. Problem of n Bodies with Variable Masses. M. Mendes. *Comptes Rendus*, 194, pp. 1794-1796, May 23, 1932.—By the method of variation of constants various forms of the equations of motion of n bodies, attracting each other under the inverse square law and whose masses are variable, are found. G. C. McV.

3593. Modern Differential Geometries. D. D. Kosambi. *Indian Journ. Phys.* 7, pp. 159-164, May 15, 1932.—A sketch of the theory of a type of differential geometry, the basis of which is the deduction of a metric from a given set of integral curves in the space. G. C. McV.

3594. Unified Theory of Gravitation and Electricity. Part II. A. Einstein and W. Mayer. *Preuss. Akad. Wiss. Berlin, Ber.* 11-12, pp. 130-137, 1932.—By an alteration in the type of five-dimensional geometry already employed (see Abstract 2309 (1932)) in dealing with this problem, it is possible to derive field-equations which are valid in regions occupied by a distribution of electric charge and current, as well as in regions occupied solely by electromagnetic forces. G. C. McV.

3595. Special Solutions of the Equations of Axially-Symmetric Gravitational Fields. T. Lewis. *Roy. Soc., Proc.* 136. pp. 176-192, May 2, 1932.—Special, exact solutions of the equations of axially-symmetric gravitational fields are derived, and two methods of successive approximation are discussed for obtaining solutions of a more general type, which behave in an assigned manner at infinity and on a surface of revolution enclosing the rotating matter to which the field is due. The solutions include as special cases those obtained by Weyl, Levi-Civita and others, pertaining to static fields. Approximate solutions for stationary fields obtained by Leuse and Thirring, Bach and Andress can be derived by suitable choice of boundary conditions when higher order terms are neglected. The gravitational equations are simplified by the use of canonical coordinates, $r + iz = x_1 + ix_2$, and are derived from a variational principle, following Weyl's method. The action function is based on a non-normalised line element and can be normalised without violating the gravitational equations. Exact solutions are given in the case of a field due to an infinite rotating cylinder in the canonical space, and the field of a rotating sphere is worked out to a second order of approximation.

J. S. G. T.

3596. Regular Solutions of Einstein's Gravitational Equations. C. Lanczos. *Ann. d. Physik*, 13. 5. pp. 621-635, May 13, 1932.—The author discusses whether the homogeneous gravitational equations $R_{ik} = 0$ can everywhere have regular solutions besides the trivial solution of the Euclidean metric, i.e., whether a curvilinear metric can be produced even when there is no matter, and, if so, wherein the difference lies between such a metric and that produced by matter. It is found that in two parallel cross-sections of the world the metrics cannot be prescribed fully as a result of the existence of the gravitational equations, although the latter are of the second order. At every point a vectorial and a scalar condition must be observed. The vectorial condition only fixes the coordinate system of the second plane, whereas the scalar condition denotes a true geometrical restriction. That is why there are no spherical harmonic proper solutions which have only one degree of freedom available which is used up by the scalar condition. Solutions, however, having a more general character of symmetry are possible. Their relations to the material field are discussed.

H. L. B.

3597. Cause of the Recesson of the Nebulae. M. S. Eigenenson. *Zeits. f. Astrophysik*, 4. 3. pp. 224-230, April 11, 1932.—The positive velocities of recession, and their correlation with distance, of the extragalactic nebulae can be accounted for by assuming that the nebulae are distributed with spherical symmetry around our own galactic system, that they move under their mutual attractions and that they radiate mass. Then it can be shown that, for an observer at the centre of the system, all the nebulae would recede with velocities proportional to their distances. The rate of loss of mass per nebula can be deduced from the rate of expansion and is roughly in agreement with the observed loss of mass by radiation within our own galaxy.

G. C. McV.

3598. Models of the Physical Universe. R. C. Tolman. *Science*, 75. pp. 367-373, April 8, 1932.—A sketch of the theory of non-static universes with special reference to the author's relativistic thermodynamics.

G. C. McV.

METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

3599. Measurements of Ultra-Violet Solar Radiation. E. Pettit. *Mt. Wilson Observat. Contrib. No. 445. Astrophys. J.* 75. pp. 185-221, April, 1932.—Evidence is given for the sun's variability, especially in the ultra-violet. The author's method is by comparing sunlight deflections at 0.32μ (ultra-violet) and 0.50μ (green) transmitted through silver and gold films. Observations are continuous since June 1924, and agree with sunspot curves except from June 1928 to June 1929. The author suggests a reason for this, but urges the need of southern hemisphere observations. At 0.32μ sun plus sky intensity on a horizontal plane varies little, and cloud makes little change. The ozone layer is localised about 50 km. above sea-level. The screening effect of ozone occurs before the scattering effect thus producing the same effect in sky and direct sunlight. There is very small ozone content in the lower atmosphere. The spectral energy curve of solar ultra-violet is investigated for Tucson, and a plot is given of atmospheric transmission; between 0.34μ and 0.33μ there is a fall due to the Huggins absorption band of ozone. A plot of solar energy shows outside the atmosphere between 0.40 and 0.38μ , a sudden drop, and then a constant value about 43 % of the maximum. At Tucson the total atmospheric ozone is equivalent to a layer 0.18 cm. thick at N.T.P.

A. S. D. M.

3600. Periodicity of Mean Annual Temperature in Relation to Sunspots. G. Viola. *Accad. Lincei. Atti*, 15. pp. 674-680, April 17, 1932.—For the time between maximum sunspots there is a double period of 23 years, the halves of which are not quite symmetrical. In examining and arranging tables of mean annual temperatures at Rome, Naples and Gaeta for 50 years and upwards a period of variability of about half that of the eleven-year sunspot period is shown.

H. M. B.

3601. Use of Cadmium Cells in Measurement of Atmospheric Transparency. U. Chorus. *Gerlands Beitr. z. Geophys.* 36. 2-3. pp. 280-303, 1932.—In order to compare sunlight at different times and in different places, it is necessary to know the relative sensitivity of the apparatus used. The sensitivity in the ultra-violet part of the spectrum of three cadmium cells is found by a monochromator and a thermopile and the sensitivity of other cadmium cells by comparison with one of the others (5725) already calibrated. Results show that the sensitivities are very varied, especially for one cell. Using these cells, the atmospheric transmission of sunlight in the region $290-324 m\mu$ is measured, and it shows that with increasing atmospheric density more of the short wave-lengths are absorbed.

H. M. B.

3602. Transparency of the Pure Atmosphere. J. Duclaux and M. Hugon. *Comptes Rendus*, 194. pp. 1842-1844, May 23, 1932.—The transparency of the atmosphere depends, according to an unknown law, on the wave-length, and the authors give data for a first evaluation obtained by visual observation or photography of distant objects in daylight under cloudless skies. For red ($\lambda = 6700$) the maximum distance is much above 317 km., and extends even to $700-800$ km. if the earth's curvature permits.

For yellow ($\lambda = 5840$) similar values occur. For blue-violet ($\lambda = 4580$) the limiting distance is above 200 km. For ultra-violet ($\lambda = 3650$) the maximum distance is about 55-65 km. Allowing for the varying density of the air traversed, values are given for the transparency at normal density for each wave-length.

R. S. R.

3603. Transparency of Air. P. Chofardet. *Comptes Rendus*, 194. pp. 1844-1846, May 23, 1932.—Observations of Mt. Blanc and other Alpine peaks, from two stations at Besançon at a distance of 165 km., have been analysed for the period 1912-1931. The monthly means show a maximum visibility in winter (Jan. and Feb.) and a minimum, 4 times smaller, for April, May and June. Visibility is best at sunrise and equally good for clear or overcast skies, while it is best for winds blowing from the ocean and thus generally more humid. It remains good when, after rain, the wind changes to east.

R. S. R.

3604. Nocturnal Transmission Coefficient of the Atmosphere of Mallorca in the Winter, 1930-31. K. Graff. *Akad. Wiss. Wien, Ber.* 141. 2a. 1-2. pp. 103-112, 1932.—A quick and fairly accurate method of measuring the transmission of the atmosphere is to find the intensity of the light from groups of stars of which the magnitude is exactly known. Comparison is made with a light source which remains constant for three months. Results obtained at sea-level on Mallorca show that the clearness of the atmosphere is nearly equal to that at Porto Cristo, at a height of 2500 m.

H. M. B.

3605. Distribution of Brightness of the Sky with Full Moon. K. Graff. *Akad. Wiss. Wien, Ber.* 141. 2a. 1-2. pp. 79-80, 1932.—A table and diagram are given to show the distribution of the light intensity of the sky at many points 24 hrs. before full moon at Mallorca on Dec. 4, 1930. Results point to the great purity of the atmosphere, a fact verified by other widely different methods of investigation.

H. M. B.

3606. Optical Phenomena During Twilight at Mallorca. K. Graff. *Akad. Wiss. Wien, Ber.* 141. 2a. 3-4. pp. 173-185, 1932.—In the winter 1930-31, measurements were made of sky effects near sunrise and sunset. Photometric instruments were installed [see Abstract 765 (1932)] to find the intensity of the light of the sky at various points. The elevation of the sun and of some of the phenomena, such as the shadow of the earth, and also their colours, were accurately measured. Tables show the time of occurrence of the phenomena, their duration and their variation in shape and colour.

H. M. B.

3607. Performance Test in Rainfall Statistics. S. R. Savur. *Indian Journ. Phys.* 7. pp. 27-34, April 1, 1932.—The author refers to Walker's performance test [see Abstract 1878 (1932)], and suggests several applications of it: (1) multiple correlation formulae for Indian rainfall given in 1920 by Walker and tested by subsequent data; (2) simple correlation coefficients for South American pressure and Indian rainfall; (3) selection of factors for a forecasting formula, e.g., rainfall; and (4) realities of periodicities as in Schuster's sunspot periods.

R. S. R.

3608. Structure of Wind Over Level Country. M. A. Giblett and Others. *Meteorolog. Office, Geophys. Mem.*, No. 54. [119 pp.], 1932.—The investigation was made at Cardington employing the records and much statistical data obtained from four Dines pressure-tube wind-speed

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and direction recorders and Baxendell direction recorder. The instruments were arranged with vanes 50 ft. above the ground, three at the corners of an equilateral triangle with 700 ft. sides and one half-way along one side. Electrical control in one hut is used to start all the records and make time marks. Another anemometer has a vane at 150 ft. and some distance away. Diagrams illustrate the lay-out and the equipment used. The possible instrumental errors are reviewed. Traces were obtained for speed and direction for normal, quick and ultra-quick runs, and reproductions are given. The traces show a larger type of disturbance with gust and lull which are most developed with an adiabatic or superadiabatic temperature lapse rate, but which disappears almost entirely with surface inversions. The ultra-quick run shows that the gust rises rapidly to a maximum and falls slowly to a minimum. Superposed on this are smaller disturbances little affected by the lapse rate until the inversion near the ground is very pronounced. The theory developed for these disturbances indicates that the latter are due to eddies or vortices set up in the main stream by friction on the ground and obstructions, and having their axes in all directions, while the diameters are of the order of 50-100 ft. The larger disturbances are due to convection currents in an unstable atmosphere. An idealised wind diagram shows the air motion in each of three cells. The cell length varies from 3000-8000 ft., the height up to or above 1500 ft., and the width from 600-2000 ft., but the dimensions vary very much. Investigations were made in steady and squally winds, and at frontal changes, for speed and direction. Four definite types of eddies—convective, wave, frictional and splashing—were distinguished with characteristic cloud forms, times of day, lapse rates, wind features and weather, and their respective features are discussed. Based on a theory of the variation of wind, certain relations for speed and direction have been obtained, and are set out. Finally, the effect of the present theory of eddies on the variation of wind with height is discussed, and it is found that simple equations of motion are only applicable to the atmosphere above a height of about 50 ft. when there is an inversion. When superadiabatic conditions are present the simple equations can be rigorously used only above a height of some 1500 ft. Values of the coefficient of turbulence are derived under certain conditions, and a table is formed showing the effect which a temperature gradient in an inversion has in reducing the value of the coefficient of turbulence.

R. S. R.

3609. Artificial Dissipation of Fog. P. Gamba. *Com. Naz. Italiano, Boll.* 2. pp. 85-90, May, 1932.—The circumstances which bring about fog are recorded and methods of dissipating and preventing them considered. The causes are often so diverse, being due to the movement of masses of air from long distances that up to the present no satisfactory means of reducing their prevalence has been found. The problem is of great importance, especially in connection with aerial navigation.

H. M. B.

3610. Kinematography of Isobaric Centres. G. Debebant. *Comptes Rendus*, 194. pp. 1673-1675, May 9, 1932.—Rules are given concerning movements of isobaric centres. Two practical forms relate to the direction of instantaneous displacement of the centre: (1) it is tangential to that of the lowest isobar in its points of intersection with the line of equal tendencies passing through the centre; and (2) it is along the line where equal tendencies are tangential to the isobars. The speed of the

isobaric centre equals that of the curves of pressure gradient along its line of travel, and is zero when the isobaric and isallobaric centres coincide. The variation of depth of the centre equals the local variation of pressure at the centre. R. S. R.

3611. Ventilation Factor. M. Robitzsch. *Gerlands Beitr. z. Geophys.*, 36. 1. pp. 133-144, 1932.—The quantity $c_p \cdot dm/dt$ which gives the coefficient of external heat conductivity in the Newtonian law of cooling is shown to be of general and meteorological importance. The term dm/dt , called the ventilation factor, is shown to possess a certain relation to the Schmidt interchange function, and depends upon the state of the surrounding medium, the form of the body and its position with regard to the vertical. Whilst the Schmidt function is defined for mass interchange in a homogeneous moving medium, dm/dt gives the mass interchange between the transition layer of a solid body and the surrounding medium. Four different methods are described by which the ventilation factor can be determined, and their reliability has already been proved experimentally. The instrumental technique has been partially developed and utilised. R. S. R.

3612. Report of the Thirteenth Annual Meeting of the American Geophysical Union. *Am. Geophys. Union, Trans.* [401 pp.], 1932.

3613. Principal Diurnal Constituent of Tidal Motion in the Gulf of Mexico. S. F. Grace. *Roy. Astron. Soc., Geophys. Supplement, M.N.* 3. pp. 70-83, May, 1932.—Reference is made to former investigations in this area by Ferrel, Harris, Endrös, Wegemann and Sterneck, and their results are critically discussed. The basin is divided into a number of rectangular basins of uniform depth, some of which may be closed across one or more sides, and applying to each hypothetical basin the solution obtained by the author for the tidal oscillations in a deep rectangular basin [see Abstract 4119 (1931)]. The elevations at points on the Gulf can then be expressed in terms of the external currents, and on equating the theoretical values for the elevations to the actual values at the observation stations, equations are obtained to determine these currents. Results of harmonic analysis of observations of tidal elevation are available for 13 stations around the Gulf. A chart was obtained giving co-tidal and co-range lines. The form indicates that except at the mouths, the K_1 tide of the Gulf is nearly simultaneous, while the semi-range increases from about 10 to 20 cm. as the basin is traversed anticlockwise from east to south. The wave takes about 6 hours to progress anticlockwise from the Florida Channel around the Gulf to the Yucatan Channel. R. S. R.

3614. Tides in a Hemispherical Ocean Bounded by a Continental Shelf. R. O. Street. *Roy. Astron. Soc., Geophys. Supplement, M.N.* 3. pp. 117-124, May, 1932.—An investigation has been made of the semi-diurnal tides in a hemispherical ocean of uniform depth, bordered along the equator by a narrow continental shelf, on which the water is of very much smaller depth. In the shallow region, the water is supposed subjected to a frictional force proportional to the speed. It is shown that except in special cases the influence of this resistance is practically restricted to the phases of the tides and the currents, and it leaves their amplitudes almost unchanged. The tides generated are nowhere large compared

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with the equilibrium tide. An exceptional case is taken where the effect of friction is important and the tides are large. R. S. R.

3615. Principal Constituent of the Tides in the English and Irish Channels. A. T. Doodson and R. H. Corkan. *Roy. Soc., Phil. Trans.* 231. pp. 29-53, May 26, 1932.—Methods explained in an earlier paper [see Abstract 2692 (1924)] for the North Sea have been further developed and applied to the construction of two new tidal charts for the English and Irish Channels and their approaches. The use of tidal currents for the calculation of gradients of the surface at a number of stations along a sectional line, together with the known coastal data, enables the surface elevation to be computed from coast to coast by graphical and numerical integration. By a network of such lines the errors of observation are smoothed out and the resulting charts conform to the observational data and to the dynamical equations of motion. Previous charts have not satisfied the dynamical conditions. The new charts show that popular conceptions of the propagation of tides are largely erroneous, as the cotidal lines do not bend inwards to the channel, *i.e.*, the time of high water is not accelerated in the centre of the channel relatively to the coast. At certain places the new charts indicate errors of as much as three hours in the times of high water as shown by older charts. R. S. R.

3616. Theory of the Lunar Tidal Variation of Atmospheric Temperature. S. Chapman. *Roy. Meteorolog. Soc., Mem. No. 34.* pp. 35-40, May, 1932.—It has been found that the lunar atmospheric tide at Batavia is accompanied by a small lunar semi-diurnal variation of temperature such as would correspond, within the accuracy of the determination, with an adiabatic variation of pressure associated with the lunar tide. In this paper the influence of the land or water underlying the atmosphere, in conducting heat to or from the air, and so reducing the tidal temperature variation near the ground, is discussed. It appears that on land this process will probably not appreciably reduce the adiabatic variation of temperature, thus agreeing with the result found for Batavia, but that over the sea the tidal variation of air temperature near the ground will be almost completely annulled. The means of testing such observations over the sea are discussed. R. S. R.

3617. Corrections of Batavia Timetables. S. W. Visser. *Union Géodésique et Géophysique Internationale, Publ. Série A. No. 7.* pp. 36-40, 1932. *In English.*—Based on records at Batavia for 167 epicentres at distances up to 120° of 1850 P residuals between ± 60 sec., and of 2097 S residuals between ± 100 sec., the following corrections (in sec.) are proposed in the 1921 tables: In the P tables for 75° , 0; 80° , -1; 85° , -2; 90° , -4; 95° , -5; 100° , -6; 105° , -7; 110° , -8; 115° , -10; 120° , -11; and in the S-tables for 30° , -1; 35° , -2; 40° , -4; 45° , -5; 50° , -4; 55° , -2; 60° , -1. The differences from the I.S.S. tables are also plotted. C. A. S.

3618. Convection Current and Surface Level of a Two-Layer Ocean. T. Nomitsu and T. Takegami. *Kyoto Coll. Sci., Mem.* 15. pp. 131-149, May, 1932. *In English.*—In order to find what difference in height of sea-level should be produced by a local difference in the density of sea-water, one of the present authors discussed theoretically in a previous paper the position of the horizontal isobaric layer in the convection current of a two-layer ocean, neglecting Coriolis force. The present paper deals with the same problem, taking the influence of the earth's rotation into

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account, and gives first the formulæ for the convection current and then the depth of the horizontal isobaric surface in a rotating ocean of two-layers. According to the result, the ratio of level difference in dynamical equilibrium to that in statical, and hence the depth of the horizontal isobaric layer measured as a fraction of the thickness of the heterogeneous upper part, is equal to unity far more nearly than in the previous case. AUTHORS.

3619. Bibliography of Seismology. E. A. Hodgson. *Dominion Observat., Ottawa, Publ.* 10. 13. pp. 213-224. Jan., Feb., March, and 10. 14. pp. 225-244, April, May, June, 1932.

3620. Recent Applications of Seismology in Italy. E. Oddone. *Union Géodésique et Géophysique Internationale, Publ. Série A. No. 7.* pp. 12-15, 1932.—Four practical applications are mentioned. It is then stated that there are grounds for believing that at the epicentre of an earthquake for approximately every thousand short shocks there is a movement of the locality as a whole, such movements being of the period of the long waves, and the cause of the seismic sea-waves. It is suggested that the loops of such waves cause fractures of the crust, and it is pointed out that the distance between successive similar variations of relief of the earth's surface are of the order of the lengths of the long waves. C. A. S.

3621. Damping of Seismometric Instruments. F. Wenner. *Union Géodésique et Géophysique Internationale, Publ. Série A. No. 7.* pp. 43-53, 1932.—The effects are examined of varying degrees of damping on seismometers (a) of ordinary type, (b) of Galitzin type, and (c) suitable for recording earth movements in the area of destruction. Types (a) and (b) are suited only for determining the commencements of the various phases, and with damping to at least 8 times the critical give similar indications, for less (b) fails to show irregular movements. For (c) an instrument of period 0.1 sec. is described, and a damping of 0.625 critical is shown to enable both actual earth movements and acceleration to be satisfactorily recorded. C. A. S.

3622. Peculiarities in the Registration of a Horizontal Pendulum Subjected to Explosive Waves. E. Oddone. *Union Géodésique et Géophysique Internationale, Publ. Série A. No. 7.* pp. 57-60, 1932.—When horizontal pendulums are subjected either to artificial or volcanic explosions, two half-waves deflected towards the direction of the disturbance are noted. An explanation is given which shows that for a single complete vertical oscillation there will be two pressure changes in the direction from which the shock originates. The theory is based on a paper by H. Lamb, published in 1904. H. M. B.

3623. Approximate Solution of the True Motion of the Ground from a Record of a Pendulum Seismometer Subject to Friction at its Recording Point. S. T. Nakamura. *Imp. Acad. Tokyo, Proc.* 8. pp. 155-158, May, 1932. *In English.*—The author starts with the equation of motion of the recording point of a pendulum seismometer $\frac{d^2S}{dt^2} + f\left(\frac{dS}{dt}\right) + F(S) = -V\frac{d^2x}{dt^2}$, where S is the displacement of the recording point, x the displacement of the ground, V the geometrical magnification of the instrument and $f\left(\frac{dS}{dt}\right)$ and F(S) are certain functions of dS/dt and S. If V, f and F are given, x can be calculated from S. The case where the frictional force is not proportional to (dS/dt) is taken, the frictional force

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being constant in magnitude and directed to arrest the motion of the recording point along the recording paper, and a solution is obtained. R. S. R.

3624. Wood-Anderson Seismograph. J. B. Macelwane. *Union Géodésique et Géophysique Internationale, Publ. Série A. No. 7. pp. 80-92, 1932. In English.*—The requirements of a seismograph for the investigation of local earthquakes are set out: (1) maximum sensitivity for the short-period oscillations of local earthquakes, (2) fairly high direct magnification, (3) negligible friction, (4) maximum fidelity or purity of the record, (5) such stability and lightness as would survive a severe shock and permit recording immediately afterwards, (6) a time scale sufficiently open to permit the study of all individual oscillations, and (7) the timing of all oscillations and impulses to the nearest 0.1 sec. and in a manner that would not be interrupted by an earthquake shock. A torsion seismometer was evolved by Anderson and Wood to satisfy these requirements. Its constructional details are explained and illustrated by plates, and its advantages over other instruments discussed. For earthquakes up to 200-300 km. the record on the short-period seismograph is better than on the long-period one. Beyond 300-400 km. sometimes one and sometimes the other is better, but they are always supplementary. R. S. R.

3625. New International Code for the Transmission of Seismic Telegrams. *Union Géodésique et Géophysique Internationale Publ. Série A. No. 7. pp. 101-122, 1932. In English.*—Full details are given of two international codes for sending (1) the epicentre and data from two or more stations, and (2) data from one station. The code provides information concerning other phases of the earthquake which are now frequently considered and which might facilitate the interpretations or help in the checking. The code is to be used experimentally and as a result of the tests adopted or modified at the Lisbon conference. R. S. R.

3626. Effect of Geological Structure upon Microseismic Disturbance. A. W. Lee. *Roy. Astron. Soc., Geophys. Supplement, M.N. 3. pp. 83-105, May, 1931.*—An investigation of the relation between microseisms and geological formation has shown that the tilting of the seismograph pillar due to microseismic oscillations is negligible and differences of subsoil cannot affect the records obtained. Love's theory of propagation of waves analogous to Rayleigh waves in a medium covered with a superficial layer is extended for compressible material and applied for layers of limestone, sandstone and clay upon granite. The ratio of horizontal to vertical movements at the surface depends upon the material and thickness of the layer. Assuming the same total energy per wavelength, the surface movements with the layers are larger than those with Rayleigh waves in granite, while for layers up to 1 km. in thickness the horizontal amplitude is affected more than the vertical amplitude. The ratio of horizontal to vertical motion is obtained for a number of European observatories. At stations on the earlier geological formations the ratio agrees with the theoretical value for Rayleigh waves. The variations in microseismic amplitude from place to place are apparently due to geographical as well as geological causes. R. S. R.

3627. Microseismic Disturbance in Great Britain during 1930, January: Comparison of Records of Seven Observatories. A. W. Lee. *Roy. Astron. Soc., Geophys. Supplement, M.N. 3. pp. 105-116, May, 1932.*—From the seismograms of seven observatories in Great Britain
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for 1930, January, the amplitude and period of the microseisms were determined for 1, 7, 13 and 18 hrs. daily. It was found that (1) the absolute amplitude of the microseisms varies over a wide range depending upon the locality and geological structure, (2) the standard deviation of amplitude in any part of the country is about 50 % of the mean, (3) the correlations of the fluctuations in (i) amplitude and (ii) mean period at different localities are respectively 0.8 and 0.6, (4) the amplitude increases as the period lengthens, (5) the standard deviation of period is < 1 sec. and (6) for systematic measurements in any part of the country about $\frac{1}{2}$ of the tabulated periods will lie between 5 and 7.5 sec. R. S. R.

3628. Causes of Microseismic Earth Movements of Period 4-8 Seconds at Athens. M. N. Critikos. *Union Géodésique et Géophysique Internationale, Publ. Série A. No. 7. pp. 5-11, 1932.*—The chief cause is the action of violent winds on the irregular surface of the earth, which produces a minute wave motion analogous to sea waves. Cases of connection between storms and increased microseisms are described. Secondary causes are the diminution in pressure over the sea bottom due to the water being blown away; and, in places, the action of sea waves on cliffs. [See Abstract 3182 (1932)]. C. A. S.

3629. Microseismic Movements at Strasburg during 1920-1929. J. Lacoste. *Union Géodésique et Géophysique Internationale, Publ. Série A. No. 7. pp. 16-35, 1932.*—The microseismic agitation of period 3-10 sec. during 1920-1929 shows as a whole a maximum in Jan. and a minimum in July, but the positions vary slightly in different years; the N-S component always preponderates. Other stations in N.W. Europe show similar results. The 6-hourly variation [see Abstract 3193 (1928)] is confirmed. The maxima coincide with the progress from the Atlantic of barometric depressions, being most marked (in descending order) when these reach (1) the North Sea, (2) the entrance to the Channel, (3) the entrance to the Baltic and (4) the Bay of Biscay [see Abstract 3182 (1932)]. These relations and connection with the Polar Front are illustrated by maps, curves and tables, as also are the effect of seismometers of different periods, and of different subsoils; thus the movements as recorded at Strasburg on alluvium are on an average 2.4 times as great as at St. Marie-aux-Mines, 53 km. distant, on gneiss. C. A. S.

3630. Annual and Diurnal Period in Distribution of 1944 Earthquakes. L. Rodès. *Union Géodésique et Géophysique Internationale, Publ. Série A. No. 7. pp. 54-56, 1932.*—When the 1944 earthquakes recorded at Tortosa during 1914-1929 are distributed according to time and season of occurrence a marked preponderance is found to occur when the most seismic areas of the earth—the Pacific generally and the Andes in particular—face the sun; also during the summer of the northern hemisphere, when the main land masses of the earth are specially subjected to extremes of temperature. C. A. S.

3631. Long Waves. J. B. Macelwane. *Union Géodésique et Géophysique Internationale, Publ. Série A. No. 7. pp. 71-79, 1932. In English.*—Instances of long waves (λ up to 4871 km.) are quoted and the absence of knowledge regarding them and the long waves which head the principal phases of seismograms emphasised. Records of long waves of the latter type recorded at Florissant (St. Louis) in seismograms of earthquakes with epicentre in the Acapulco deep, due south of the station, VOL. XXXV.—A.—1932.

are quoted to show their varying character, and in some cases complete disagreement with Gutenberg's statements concerning such waves.

C. A. S.

3632. Reflection of Seismic Waves at the Antipodes as Cause of New Earthquakes. G. Agamennone. *Accad. Lincei, Atti*, 16. pp. 729-733, May 1, 1932.—The author discusses Oddone's theory in which he seeks to prove that the seismic waves generated by a violent shock are able to propagate themselves along the earth's diameter and after undergoing reflection at the antipodes to return on their path and after arrival at their point of departure to provoke there another shock (first repetition) of less intensity through dissipation of energy during the double transit. It was also suggested that the repetition is capable of reflection at the anti-epicentre, and on returning to its epicentre can excite there a new disturbance (second repetition) of still less intensity. The author has examined various records of earthquakes and is led to a negative conclusion regarding Oddone's hypothesis. He gives various reasons for regarding the hypothesis as not proved.

J. J. S.

3633. Present Position of the Isostasy Problem. W. Heiskanen. *Gerlands Beitr. z. Geophys.* 36. 2-3. pp. 177-205, 1932. *In German.*—Recent work is discussed and in particular Meinesz' observations in the West and Dutch Indies. It is deemed proved that the greater part of the earth's crust is in isostatic equilibrium, but volcanic areas are regions of excess, the great ocean deeps of defective mass; deltas are probably in equilibrium; Airy's hypothesis is more in accord with facts than Pratt's; the thickness of the crust (sial layer) varies from nil under the deepest ocean to 70 km. under mountains; for determining the warping of the geoid isostatically determined gravity anomalies are best. There remain the questions of possible ellipticity of the equator, warping of the geoid, origin of excess mass in oceanic areas, and extent and position of compensation. For these the joint work of geodesists, geologists and seismologists is necessary.

C. A. S.

3634. Method for Testing Airy and Pratt Isostasy. W. Bowie. *Gerlands Beitr. z. Geophys.* 36. 2-3. pp. 171-176, 1932. *In English.*—To determine the horizontal extension of compensation numerous closely spaced gravity stations in rugged areas are required. Airy's hypothesis requires the depth of compensation to increase with the average elevation of stations; 56, 20, and 8 stations in the United States, Canada and Mexico at average elevations of 3835, 2675 and 8595 ft. give depths of 95, 99 and 94 km. respectively—an inconclusive result. To decide between this and Pratt's hypothesis numerous deflection of the vertical and gravity determinations are required in rugged (not plateau) mountainous regions, each geologically similar area being dealt with separately.

C. A. S.

3635. Isostatic Compensation. A. Prey. *Gerlands Beitr. z. Geophys.* 36. 2-3. pp. 242-268, 1932. *In German.*—In a manner similar to that previously followed [see Abstract 2608 (1931)] for a non-isostatic earth the form of the geoid, gravity at the earth's surface, and results of reduction are calculated for complete isostatic compensation according to Pratt's method (as easier for calculation than Airy's and giving almost identical results). Thus determined the warping of the geoid is ± 47.5 m. in Central Asia and -24.9 m. in the Pacific, with an error of ± 2 m. The ellipticity of the equator is ± 6 m. Jung's results [see Abstract 1489

(1931)] are compared. Tables of gravity anomalies according to the free air method, and to Bouguer's method (a) with full and (b) without compensation are given. Results under (a) fit observations much better than under (b), and support isostasy. Jeffreys' results [see Abstract 755 (1932)] are confirmed. C. A. S.

3636. Figure of the Earth. H. Jeffreys. *Gerlands Beitr. z. Geophys.* 36. 2-3. pp. 206-211, 1932. In English. Hopfner's method, based on that of Bruns [see Abstract 1549 (1932)] was anticipated by Stokes. A new and simpler method of arriving at Stokes' solution is given [see Abstract 755 (1932)]. Heiskanen's view (though not his proof), that the ellipticity of the equator is a fact, is upheld in preference to Hopfner's. C. A. S.

3637. Determination of Warping of Geoid, and of Oblateness of the Earth. K. Jung. *Gerlands Beitr. z. Geophys.* 36. 2-3. pp. 212-241, 1932. In German.—Ackerl's results [see Abstract 2995 (1931)] are disputed on the grounds that (1) the method of calculating the warping of the geoid derived from Bruns', Hopfner's and Prey's methods is incorrect in that it omits the gravity effect of masses immediately above and below the point on the geoid concerned [see Abstracts 765, 1489, 2608 (1931)], and that Clairaut's theorem is only applicable to gravity values reduced by Prey's method with addition of a term relating to masses outside the geoid; and (2) the gravity determinations over the oceans are mainly based on observations on oceanic islands which Meinesz' results in the West and Dutch Indies show to be very different from those over the main oceans—this specially affects the southern hemisphere. Correcting for (1), and using Ackerl's values for the northern hemisphere only, the ellipticity reduces to $1/287.4$, which would be further reduced by corrections for (2). Even corrected as above the method is inapplicable to determining the warping of the geoid owing to accidental agreement between unrelated terms, and the inaccuracies of Bouguer's reduction, but certainly there seems no reason to accept Ackerl's large value. In a Reply F. Ackerl disputes objection (1). C. A. S.

3638. Deformation of the Earth due to Unsymmetrical Cooling. H. Jeffreys. *Roy. Astron. Soc., Geophys. Supplement, M.N.* 3. pp. 53-59, May, 1932.—The present form of the thermal contraction theory considers only symmetrical changes and does not explain upheavals and depressions of the earth's surface of the horizontal extent of continents rather than of mountain systems during geological time. Since the distribution of radioactivity in the crust is most probably non-uniform, the cooling in some regions of the crust has been greater than in others. Mathematical relations are established relating to the elastic distortion of the earth due to unsymmetrical cooling. Since solidification in continental conditions, an average volume contraction of 5 % due to cooling to a depth of about 400 km. has occurred and below the oceans about $1\frac{1}{2}$ times this amount. This leads to a difference of radial contraction of the order 10 km. as between continents and oceans and therefore a progressive deepening of oceans in geological time. Similarly it may account for the foundering of parts of continents and the formation of land bridges and geosynclines. R. S. R.

3639. Stresses in the Earth's Crust Required to Support Surface Inequalities. H. Jeffreys. *Roy. Astron. Soc., Geophys. Supplement, M.N.* 3. pp. 60-69, May, 1932.—Reference is made to the results already VOL. XXXV.—A.—1932.

obtained for harmonic loading, the distribution of stresses in the earth's crust, and the total strain energy [see Abstract 1884 (1932)]. In the present paper the stresses produced by an elevated or depressed strip are considered for various conditions of loading and the results indicate that the strength required in ordinary cases to support a surface inequality is about one-third of the range of load. For a range between the highest Himalayan peaks and neighbouring valleys the strength required is a little under half the crushing strength of granite in laboratory conditions, while for the great oceanic deeps a somewhat greater strength is necessary. After a discussion of stresses in a thin crust floating on a sphere the anomalies are found to be best explained by assuming the lower layer is not in a hydrostatic state and the inequalities of mass distribution implied by the anomalies in gravity may be supported by stresses in the lower layer.

R. S. R.

3640. Origin of Comets. S. Vessiviatzky. *Observatory*, 55, pp. 146-148, May, 1932.—The author urges the following objections to the capture theory of comets. (1) Out of 100,000 comets, with sensibly parabolic orbits, that are visible from the earth, only one should have its period reduced to 30 years or less; actually there are found about 16 new short-period comets to 100 parabolic ones. (2) Short-period comets diminish in brightness so rapidly that their existence as visible comets is short. (3) No comets of periods under 33 years are retrograde. (4) Many comets have smaller e than is allowed by Tisserand's criterion for the inferior limit to the eccentricity of an orbit derived by a parabolic one by capture. (5) The region of maximum frequency of perihelion points is nearer the sun for parabolic than for short-period comets, but capture should diminish perihelion distance in the case of direct motion. He suggests a study of the surfaces of the large planets for observation of such expulsion of matter. The short existence of short-period comets seems to disprove the theory advanced by Bobrovnikoff that asteroids are the result of the disintegration of a large comet.

A. S. D. M.

3641. Meteors. R. A. McIntosh. *Roy. Astron. Soc., Canada*, J. 26, pp. 193-210, May-June, 1932.—A popular summary, including some notes on the author's work in New Zealand.

T. L. M.

3642. Meteorite Craters. L. J. Spencer. *Nature*, 129, pp. 781-784, May 28, 1932.—The meteor craters of Arizona, Texas, Oesel Island, Siberia, and Henbury in Australia are described and compared. Accompanying illustrations show the Arizona crater photographed from the air, the numerous craters at Henbury, and some typical fragments of meteoric iron which were found scattered round them. Here there must have been not a single meteorite but a shower, and the natives seem to have some tradition of their fall.

M. A. E.

3643. Reinmuth Object. M. Davidson. *Roy. Astron. Soc., M.N.* 92, pp. 691-693, May, 1932.—Planet 1932 HA (Reinmuth), discovered April 24, 1932, is the first minor planet coming within Earth's orbit; it is very small, 1 or 2 miles, therefore only observable at near approaches. Several approximations to the orbit are described; special methods are necessary; Crommelin determined the geocentric distance from the parallax. The minimum distance from Earth was about 0.07 A.U. (May 15). The semi-major axis is 1.4, but the eccentricity is high, over 0.5. The period exceeds 1.75 years.

T. L. M.

3644. Tides and Motion in Planetary Systems. G. Krall. *Accad. Lincei, Atti*, 16, pp. 664-668, April 17, 1932.—Here the author takes up the problem of $(n+1)$ bodies and the characteristic general function for rotating bodies, with the characterisation under extreme conditions. [See Abstracts 1560 and 3186 (1932).] A. D.

3645. Aspect of Lunar Surface. H. G. Tomkins. *Roy. Astron. Soc., M.N.* 92, pp. 557-562, April, 1932.—It is assumed by some geologists that a complete and uniform shell of non-crystallised eruptible basalt underlies everywhere the earth's crust, and this is known as "the substratum." It is suggested that a substratum may also exist on the moon, but so much nearer the surface that in many regions it becomes visible, and can often be traced as very dark patches beneath shallow surface coverings of lighter material. This effect is shown in photographs taken at or near full moon, so that no shadows are present, and the plates and methods used to ensure maximum contrast are described. M. A. E.

3646. Application of Hollerith Tabulating Machine to Brown's Lunar Tables. L. J. Comrie. *Roy. Astron. Soc., M.N.* 92, pp. 694-707, May, 1932.—Brown's Tables contain values of the coefficients of 1400 harmonic terms in the moon's motion, combined only where the periods are commensurable. The work is to select and add the appropriate values for ephemeris dates: examples of the method are given. The Hollerith machine operates by counting from the position of holes punched in specially prepared cards; the tabular entries therefore require to be transferred once only to cards and methods of bringing the appropriate cards together devised; the machine adds the terms mechanically and prints the results. The mechanism and the methods used are fully described and illustrated. The method of closing the operation when the cards of one date have been added and resuming on the following date is entirely automatic. Verification of the punching was done by letting the machine print the individual values and proof-reading these. It is estimated that the machine has reduced the cost of the work to one-quarter and accelerated the work tenfold. Other applications of the machine are suggested, e.g., in tide prediction. T. L. M.

3647. Hindu Luni-Solar Astronomy. P. C. Sengupta. *Calcutta Math. Soc., Bull.* 24, pp. 1-8, March, 1932.—The author finds that the Hindu equations of the sun and constants in solar and lunar astronomy and of solar and lunar semi-diameters are more correct than the Greek (Hipparchus-Ptolemaic), but the Hindus restricted their observations of the moon to the time when she was near a node; he concludes that in spite of vague Greek transmission, astronomy as developed by Āryabhata and Brahmagupta is original and independent. Especially Mañjula's rediscovery of the second moon inequality predating Tycho Brahe's rediscovery by several centuries entitles him to recognition. A. S. D. M.

3648. Eclipse Projector. J. Stokley. *J.O.S.A.* 22, pp. 239-244, May, 1932.—A triple-projecting lantern has been constructed by the Bausch and Lomb Optical Co. for the Franklin Institute, Philadelphia, to show on a screen the progressive phases of solar eclipses. A partial, annular and total eclipse can be simulated. Totality lasts for about 10 sec., with corona and prominences (coloured red), and Baily's beads are seen before and after this phase. A series of figures illustrates the instrument and the effects produced. M. A. E.

3649. Photometry of H β in the Chromospheric Spectrum Outside of Eclipse. P. C. Keenan. *Astrophys. J.* 75. pp. 277-297, May, 1932.—Photometric measurements on spectrograms taken at the limb of the sun outside of eclipse were carried out to give preliminary contours of H β at various heights in the chromosphere. The errors entailed by the observational integration of the false light superimposed upon the true chromospheric spectrum by scattering and scintillation in the earth's atmosphere prevent the deduced contours and intensities from being very exact. Observations at time of eclipse will probably be necessary to furnish precise results. However, the width of the line can be determined more accurately and is found to be strikingly constant throughout the lower 2000 km. of the chromosphere. In this same region the total intensity also varies but little. The measurements were used in connection with Unsöld's equation for intensities within emission lines in the chromosphere to obtain approximate average values for the coefficient of scattering and the density of hydrogen atoms in the layers above 300 km. The computations gave 12×10^{-10} for s_0 and 3000 atoms per c.c. for N. AUTHOR.

3650. Study of Atomic Lines in Sunspot Spectrum. Charlotte E. Moore. *Mt. Wilson Observat. Contrib. No. 446. Astrophys. J.* 75. pp. 223-273, April, and 298-336, May, 1932.—The author uses 6312 atomic lines from the Mt. Wilson spectrum map, 1915-1917. Tables are given of all known spot lines, of 21 new solar lines (from Ti, V and Cr), of predicted solar lines of 13 elements (in a neutral and/or ionised state); 13 other elements are possibly absent, and 16 elements certainly so. Yb is the only rare earth in a neutral state; all others are ionised; the rare earths do not reverse suddenly in the flash, as absorption lines do. Even atomic number elements are 10 times as numerous as odd. A quantity Y is found, which when plotted against the excitation potential gives a line whose slope is the same for all elements in the star, and gives the temperature. This slope from 6 elements gives $4720^\circ \pm 40^\circ$ K. for the spot mean effective temperature, accepting Milne's value of 5740° K. for the photosphere. This has been checked in two ways. Electron pressure over a spot is 0.60 ± 0.10 of that over the disc; the diminished ionisation means greater transparency of material; the reversing layer is thicker over spots but the electron pressure lower; these are due to the difference in effective temperatures of spot and disc. A. S. D. M.

3651. Distribution of Intensity of Fraunhofer Lines. Part I. Residual Central Intensity. A. Unsöld. *Zeits. f. Astrophysik*, 4. pp. 319-328, May 30, 1932.—The re-emission theory involves central blackness, contrary to observation; it is therefore proposed that the electron can be expelled further by radiation, e.g., from 3^2P to 2^2D or 3^2S , by another light-quantum, before falling back to 3^2S . Pannekoek's pressure-effect difficulty is thus avoided. Re-emission and absorption are then connected only by Kirchhoff's equation (approximately). The residual intensities given by the new theory are compared with observation (d'Azambuja, Plaskett, Minnaert) for several solar lines. The new theory, unlike the older, does not demand that giant star lines should have smaller residual intensities than dwarfs; the observations of C. H. Payne in confirmation of this have therefore to be attributed to an instrumental effect; the author desires to have this investigated with greater dispersion. T. L. M.

3652. Graphic Computation of Solar Altitude. A. F. Dufton. *Phil. Mag.* 13. pp. 1128-1130, May, 1932.—The equation: $\sin h = \cos \delta \cos \phi \cos t + \sin \delta \sin \phi$, which for latitude ϕ expresses the altitude h in terms of the declination δ and the hour angle t , is theoretically transformed so that an alignment diagram can be drawn. A figure shows the diagram for the latitude of London $51^{\circ} 31' N$. H. M. B.

3653. Computation of Radial Component of Solar Motion. A. F. Dufton. *Roy. Astron. Soc., M.N.* 92. pp. 688-691, May, 1932.—A method of graphical elimination of the solar motion from stellar observed radial velocities has been given by J. A. Pearce and S. N. Hill. The author writes their equation in determinant form, reduces the problem to one of collinearity, and gives an alignment nomograph which is simpler to construct and more convenient to use, since interpolation is on simple scales. T. L. M.

3654. Hydrogen Content of the Stars. A. S. Eddington. *Roy. Astron. Soc., M.N.* 92. pp. 471-481, April, 1932.—On the assumption that stars are constituted of perfect gas throughout and that the absorption coefficient is given by Kramers' theory, it is possible to compute the proportion of hydrogen in a star necessary to give the observed luminosity when the mass and radius are known. The calculations are performed for the sun, Capella, Algol, Krueger 60 and some other stars, and two solutions are found for each star: one with a proportion of $99\frac{1}{4}\%$ H and another with 33% H. The latter is taken as the correct one. The H content is the same from star to star. The new composition for the stars, however, increases the difference between calculated and observed periods of Cepheids [see also Abstract 3201 (1932)]. G. C. McV.

3655. Structure of our Star System. Part II. Distribution of Star Spectra in 43 Southern Fields. F. Becker. *Preuss. Akad. Wiss Berlin, Ber.* 11-12. pp. 86-104, 1932.—With the completion of zone -45° of the Potsdam Spectrum *Durchmusterung* [see Abstract 3687 (1930)], all the 43 Kapteyn areas from this declination to the South Pole can now be analysed. The 33,000 stars which appear on the plates have been classified in eight groups of spectral classes and three of brightness. Star density decreases with increasing distance from the galactic plane, but not uniformly: rich and poor regions exist side by side, and it may be that the system ends rather suddenly. The frequency of stars increases from B to M along the Main Series, but giants are comparatively rare. In the central zone of the galaxy are congregated many star-clouds, and these include more B stars than any other type, but in high galactic latitudes there is almost everywhere a mixture in space of stars from A to K of the Main Series. Types O, R, N and S are extremely rare. M. A. E.

3656. Analysis of Line Intensities in Stellar Spectra. R. v.d. R. Woolley. *Roy. Astron. Soc., M.N.* 92. pp. 482-500, April, 1932.—Eddington's model, $1/(1+\eta) = \alpha + \beta\tau$, where η is the ratio of the coefficients of line and of continuous absorption, τ is the optical depth and α, β are constants chosen to fit calculated distributions of neutral and ionised atoms, is applied to stellar atmospheres. The maximum of the Balmer lines of A-type stars is accounted for quantitatively. The relation of the ratio of number of neutral to ionised atoms at a prescribed optical depth to the widths of the lines is also found. From pairs of lines from

different elements the temperature and the value of gravity at the surface of the star can be found. The calculations are performed for various G-type stars. G. C. McV.

3657. Interpretation of Early Spectral Class Emission Lines. O. Struve and P. Swings. *Astrophys. J.* 75. pp. 161-184, April, 1932.—FeII is present in types B0-B5. The authors assume that bright lines originate in an outer gaseous shell or ring distant from the star which is not in thermodynamic equilibrium; possibly they are caused by recombination of free electrons with positive ions giving a maximum concentration of Fe^{++} in the late B-stars. It is therefore assumed that the state of ionisation is about the same in the nebulous shell and in the star's reversing layer. A search is made for elements giving other bright lines similarly excited, and certain evidence is found for MgII and SiII, probable for ScII, CrII and NiII, uncertain for Merrill's forbidden FeII. In any star the different elements do not give the same line widths; this is perhaps due to their differing distances from the star; by this argument MgII is distant about 7 times the star's radius and H 10 times. The density of the shell is roughly 2.5×10^{-13} gm./cm.³. Since the bright lines are in some way excited by photospheric radiation, the authors arrange the bright line spectra in order of class as given by the absorption lines. Within any subdivision there is similarity of emission spectra (except for Mira's Companion and β Lyræ) indicating that the density of the shell multiplied by the dilution factor is constant for a given subdivision but varies as a function of spectral type. Data are given for a new Be star (60 Cygni) having variable hydrogen lines, and H variations for 31 Pegasi; the broad and hazy absorption lines of He and MgII and the sharp and narrow lines of FeII are discussed, it being urged that the hazy lines are broadened by rotation, and the narrow by absorption in the same rotating gaseous shell as gave rise to the bright H lines and to their narrow central absorptions. The arguments for (by the authors) and against (by Miss Payne and Maubetsch) the origin of the bright lines through a rotating shell or ring of gas are discussed. A. S. D. M.

3658. Photoelectric Colours of Stars of Early Type in Cepheus. C. T. Elvey and T. G. Mehlin. *Astrophys. J.* 75. pp. 354-363, May, 1932.—The colours of 49 stars of spectral types B3 and earlier in the region of Cepheus have been determined with the photoelectric photometer attached to the 40-in. telescope of the Yerkes Observatory. Stars as faint as the ninth magnitude were observed. The colour excesses of the stars fail to correlate with the intensities of the interstellar calcium line, and hence the material producing the selective scattering of the star's light is not coexistent with the calcium atoms. The correlation of colour excess with apparent magnitude gives a coefficient of +0.49. This correlation may be the effect of the scattering of light produced by the partially obscuring dark clouds observed on photographs of the region. It is found that the stars of small colour excess are in the unobscured regions and those of large colour excess are in the obscured regions. AUTHORS.

3659. Spectroscopic Parallaxes of Early-Type Stars in Moving-Clusters. C. Jane Anger. *Harvard Coll. Obs. Circ.* 372. [14 pp], April 4, 1932.—An extension of the author's previous work [see Abstracts 4137 and 4138 (1931)] to Rasmussen's Perseus Cluster. The zero point was previously set only by the Ursa Major cluster stars, and the scale by

Scorpio-Centaurus and Orion nebula stars; it is now extended and parallactic motions are introduced. The hydrogen line intensities have been measured for spectroscopic parallaxes in the Perseus cluster and in Kapteyn's regions; the corrections for spectroscopic binaries are $0^m.35$ for one-spectrum, including velocities "probably variable," and $0^m.60$ for two-spectrum; the helium line 4028 intensity is a good criterion of luminosity for early stars and for hazy line stars, it is given by correlation with Scorpio-Centaurus stars. The author compares her system with others and plots the space coordinates; the well-known inclination of bright stars to the galactic plane is evident in the xz plane; the Orion and Scorpio-Centaurus streams seem to merge; a rift is indicated in the Carina direction and seems to be real. A catalogue of the Perseus cluster stars is given. A. S. D. M.

3660. Rotational Space Motions of the Stars. J. M. Mohr. *Roy. Astron. Soc., M.N.* 92. pp. 562-593, April, 1932.—The consequences of the theory of galactic rotation have been examined by computing stellar space velocities (with elimination of the solar motion), and calculating stellar masses by Eddington's method. As a result, the theory is confirmed, and a series of observed stellar phenomena is satisfactorily explained. The study is based on 1678 stars of types B to M. The following conclusions are reached: The velocity of homogeneous star-groups at any distance within 1-150 parsecs from the galactic plane, in both directions, is constant. In curves of velocity distribution for giants the maximum distribution is between 280 and 300 km./sec. There is a higher dispersion of velocities for dwarfs, which corresponds with the greater eccentricity of their elliptic orbits round the galactic centre, but their mean velocities are higher than those of giants. Giants' orbits are more nearly circular. (The higher velocities of smaller masses may possibly be due to resistance of interstellar matter.) Higher proper motions are correlated with smaller rotational velocities, both in giants and dwarfs. Rotational velocity depends also on the direction of motion towards peri- or apogalacticum. Thus, the sun's high velocity of 300 km./sec. is due to its being a dwarf and also to its movement towards perigalacticum. The distance of the galactic centre from us is 10,000 parsecs, and its longitude is about 350° . M. A. E.

3661. Variations of Radial Velocity and of Intensity of Spectral Lines in $12\alpha^2$ Canum Venaticorum. Goldena Farnsworth. *Astro-phys. J.* 75. pp. 364-370, May, 1932.—Velocity curves of α^2 Canum Venaticorum were determined for several individual lines and compared with intensity curves determined from the same plates. A revised period depending upon observations of Belopolsky and upon spectrograms obtained in 1931 at the Yerkes Observatory was used. It is suggested that the observed changes in radial velocity are apparent and are caused by the effect of blending with other lines, near minimum of intensity of the lines considered. The star should probably be regarded as having a constant radial velocity within the precision of the measurements.

AUTHOR.

3662. Mass and Eccentricity of Binaries. G. Armellini. *Accad. Lincei, Atti.* 15. pp. 701-706, May 1, 1932.—When the mass of a binary decreases, the mean distance of the components rises. In most cases also the eccentricity increases with time, and the path of a satellite tends to

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become a hyperbolic spiral. The rate of decrease of the mass may be very slow. E. E. F. d'A.

3663. Spectroscopic Binary B.D.-18°3295. R. N. van Arnem. *Astrophys. J.* 75. pp. 348-353, May, 1932.—The orbit of B.D.-18°3295 (Boss 3138) was revised with the aid of 14 new spectrograms. The new period is 2.96310 days; $\gamma = +3$ km./sec.; $e = 0.057$; $\omega = 68^\circ 8'$; $T = 1931$, Feb. 5, 21^h.239 U.T.; $K_1 = 120.5$ km./sec.; $K_2 = 225$ km./sec.; $a_1 \sin i = 4,900,000$ km.; $a_2 \sin i = 9,150,000$ km. The secondary spectrum was measured for the first time, and a mass ratio of secondary to primary of 0.53 determined. The minimum masses of the primary and secondary components are 8.2 and $4.4\odot$, respectively. The contours of the helium line λ 4472 indicate a radial equatorial velocity of rotation of the order of 100 km./sec. From the contour areas of the two components of λ 4472 the ratio of the radii of the stars is found to be 1.5. AUTHOR.

3664. Double Stars. R. G. Aitken. *Roy. Astron. Soc., M.N.* 92. pp. 596-610, May, 1932.—A history is given from 1802 to 1932, when there was published an extension of Burnham's General Catalogue (1906) by Doolittle and the author. This does not duplicate Burnham but is independent, setting a definite limit based on angular separation and magnitude within which all pairs must fall. These limits are defined by $\log p = 2.8-0.2m$, giving angular separation $10''$ for a pair of combined magnitude 9.0; this formula excludes nearly one-third of Burnham's 13,665 pairs. The new catalogue contains 17,180 entries, of which 12,708 fall within the narrower limit of $5''.0$ for combined magnitude 9.0. One star in 18 as bright as 9th magnitude is a close double within the resolving power of modern telescopes, and the number of visual doubles increases with smaller angular distance, a fact supported by spectroscopic binaries. Doubles concentrate towards the galactic plane. An unexplained feature is the small number of close pairs in the 4th quadrant of right ascension. Eccentricities and periods increase with increasing galactic latitude and are larger for galactic longitudes $180-270-360$ than the other semicircle. Eccentricity also increases with period. Equal magnitude components are similar in colour and spectrum. A. S. D. M.

3665. Eclipse of Companion to Zeta Aurigæ. P. Guthnick and H. Schneller. *Preuss. Akad. Wiss. Berlin, Ber.* 8-10. pp. 57-72, 1932.—This star is a spectroscopic double, consisting of a bright component with spectrum K5 and a faint B-type component; and the character of the spectra suggests that both components are in rapid rotation. The radial velocity varies in the unusually long period of 973 days, and it was suggested that the star might be an eclipsing variable with an eclipse due in Jan., 1932. This actually began in Dec., 1931, and lasted for about 40 days, giving an opportunity to calculate for the first time, independently of any assumptions regarding parallax, etc., the diameter and the mass of a red supergiant. The photometric and spectroscopic observations show that the radius of the K star is approximately 250 times and the mass 30 times that of the sun, and the radius and mass of the B-star 3 times and 12 times that of the sun. An unsymmetrical widening of lines at the beginning and end of totality probably confirms the hypothesis of rapid rotation. The white star should pass across the red star in Oct., 1932, but probably there will be no noticeable effect, on account of its small relative size. M. A. E.

3666. Variable Star V Sagittæ. P. M. Ryves. *Roy. Astron. Soc., M.N.* 92, pp. 715-719, May, 1932.—Visual observations on 1243 nights in 1910-12 and 1923-31 are discussed; difficulties in reduction arose from personal equation and faintness of comparison stars. Owing to rapid variation, frequent observation was required; some observations were therefore under unfavourable conditions; the reliability of estimates is discussed. The variation is analysed into (1) slow periodic variation, about 530 days, range 2 magn., with irregularities; (2) secondary variation, producing triple maximum at intervals of about 130 days in most periods; (3) rapid fluctuations, nearly always present, sometimes markedly periodic (12 days, 1910; 17-18 days, 1927; 16 days, 1928), including occasional deep minima. The types of rapid fluctuation are described; there is a tendency to return to the appropriate point on the long-period curve after a fluctuation. It is suggested that the star may be a former Nova. The author regrets the absence of spectrum information. T. L. M.

3667. Explanation of Quasi-Periodic Variable Stars. K. Hirayama. *Imp. Acad. Tokyo, Proc.* 8, pp. 143-146, May, 1932. *In English.*—An extension of the author's previous work [see Abstracts 3391 and 4142 (1931)]. He assumes that a star at birth is of the nature of a small spherical nebula and the extreme case of a dwarf star penetrating centrally the nebulous star, its elliptic orbit being thus a straight line; he enquires how the orbital elements vary, finding that the major axis and period vary largely. He examines the three irregular variables, U Gem, SS Cyg and SS Aur, in which the minimum is long and nearly constant and the maximum is very short; in U Gem he considers the two kinds of maxima, alternating broad and narrow, lasting about 20 and 12 days, and finds that the period has diminished about 35 % per century, and gives reasons for the alternation, as corresponding to emersion and immersion. If in a case of such rectilinear oscillation the nebulous star is dark and the dwarf companion sufficiently light, the system will be observed as an Algol-type variable with irregular period. A. S. D. M.

3668. Irregularities of Period of Long-Period Variable Stars. S. Plakidis. *Roy. Astron. Soc., M.N.* 92, pp. 460-471, April, 1932.—An investigation covering 17 variable stars to discover whether certain features of the periods of the stars α Cet and χ Cyg were common to all variables of the class. The general conclusion is that none of the stars show periodic irregularities, but four, viz., R Aur, RU Ma, R Hya and R Agl, show signs of repeated irregularities. In these stars the periods are decreasing by successive jumps. A. S. Eddington, in a note, concludes from the investigation that, excepting these peculiar stars, nearly three-quarters of the stars examined are variables with accidental fluctuations of period, the mean deviation from the average period being from 1 to 2 %.

G. C. McV.

3669. Secular Variations in the Periods of Cepheids. B. W. Kukarkin and N. Florja. *Zeits. f. Astrophysik*, 4, pp. 247-254, May 30, 1932.—Eight δ -Cephei stars have been long and closely enough observed for the secular variation in their periods to be deduced by means of the Hertzprung method, and it is found that the variation can be expressed by the formula $P = P_0 + dP$. E. Eddington pointed out long ago that with progressive decrease in mass through radiation and consequent increase in density the periods of Cepheids should progressively decrease,

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but only two in this list do so. It is possible that the observed secular change is only part of a fluctuation round about a mean period, and that the life of a Cepheid is much longer than supposed. Investigations are now proceeding with other Cepheids, but the necessary data only exist for very few. M. A. E.

3670. Periods and Light Curves of 32 Variables in Globular Clusters, N.G.C. 362, 6121 and 6397. Helen B. Sawyer. *Harvard Coll. Obs., Circ.* 366. [36 pp.], May 1, 1931.—In N.G.C. 362 one significant variable has a period of over 105 days and median magnitude (1·7) brighter than the cluster type, like the one in Messier 5 (106 days and 1·2 magnitudes brighter); N.G.C. 6397 also contains a variable of the peculiar RV Tauri type. Curves are given of composite and bolometric period-luminosity for Cepheid and long-period variables. The former indicates that 3 Cepheids apparently within N.G.C. 362 really belong to the small Magellanic Cloud, and that 5 long-period variables form a distinct group with median absolute magnitude (photographic) of about -1·5. The latter shows that the long-periods follow on the Cepheids in the same curve. Cluster-type variables have a tendency to periods about half a day, but with notable gaps at periods of 0^d·43 and 0^d·64. A. S. D. M.

3671. Photometric Observations with the Large Refractor at Vienna. C. Wirtz. *Akad. Wiss. Wien, Ber.* 141. 2a. 3-4. pp. 163-172, 1932.—This instrument, of 67·5 cm. aperture, was used in 1931 for photometric measurements, with a Graff photometer having a Steinheil wedge. Saturn's disc and ring were compared, and the surface brightness estimated of the planetary nebula N.G.C. 7009 and the globular cluster N.G.C. 7089. Visual estimates of brightness and colour in nebulae, and in different parts of the same nebula, are very desirable, but bad weather greatly hindered this programme. M. A. E.

3672. Photometric Survey of Nearer Extragalactic Nebulae. H. Shapley and Adelaide Ames. *Harvard Coll. Obs., Bull.* No. 887. pp. 1-6, May 1, 1932.—A preliminary study of a catalogue of 1025 nebulae brighter than the 13th magnitude. The primary virtue is its essential completeness and fair magnitude homogeneity. Three diagrams are given: (1) of the whole (291 brighter than the 12th magnitude and 734 fainter), with the central Milky-Way line indicated and showing no general concentration towards the local galactic system; (2) for the northern galactic hemisphere (195 brighter than 12th magnitude and 490 fainter); and (3) for the southern (96 brighter than the 12th magnitude and 244 fainter). These all emphasise the non-uniformity of distribution, the vacancies in high latitude being real. The catalogue is a fair view of the population within some million parsecs of the sun so far as normal-sized galaxies are concerned; probably all average galaxies (except in low latitudes) are included up to 3 megaparsecs; those as bright as M 31 up to 7 megaparsecs; dwarf systems like N.G.C. 205 would be invisible at 1 megaparsec. Spiral structure is shown by 700 objects; 200 are spheroidal; the rest are irregular or unclassified. A. S. D. M.

3673. Formation of Spiral Arms. B. M. Peek. *Roy. Astron. Soc., M.N.* 92. pp. 707-715, May, 1932.—It is assumed that the density of the arms is small and the central mass sensibly constant. It is considered that after the ejection of arms has commenced the points of ejection will rotate with the last ejected matter, that is as if fixed on the surface of the

nucleus. Several laws of contraction of the nebula are considered; reasonable forms lead to spirals which correspond better with observed forms than the equiangular spiral; this is illustrated for M 81. The time-scale is considered and is of the order of 10^8 years. The time required for the evolution of a galaxy until the matter constituting the arms becomes unrecognisably disturbed is estimated at between 10^8 and 10^{10} years. An examination of the relation between distance and number of convolutions is proposed. T. L. M.

3674. Temperatures of Wolf-Rayet Stars and Novæ. C. S. Beals. *Roy. Astron. Soc., M.N.* 92. pp. 677-688, May, 1932.—Two equations for the number of quanta emitted per second should, according to Zanstra's theory, give equal numbers for steady state. The solution is determined by trial and the temperature of the star is that which gives the equal values. One expression involves an observational quantity depending on the strength of the individual lines of the series considered. The method of determining this quantity is detailed. The resulting temperatures differ greatly from colour temperatures for the same objects; the problem is not resolved but reasons for confidence in the present method are given. Results: for two Wolf-Rayet stars, $70,000^\circ$, Nova Aquilæ $65,000^\circ$, P. Cygni $25,000^\circ$. The problems of these objects are discussed individually; they are regarded as typical of their classes. T. L. M.

3675. Rayleigh Scattering and Anomalous Star Temperatures. B. P. Gerasimovič. *Zeits. f. Astrophysik*, 4. pp. 265-281, May 30, 1932.—The hypotheses that have been made to account for the anomalous colour temperatures of many bright O- and H-stars, and that are based on the Rayleigh scattering caused by the stellar atmospheres on the surrounding clouds of cosmic dust, are subjected to a critical analysis. Only two hypotheses are shown to be acceptable from the physical and the astronomical point of view. The anomaly may be peculiar to the star itself, that is, to its photosphere, or it may be the consequence of certain local clouds of cosmic dust which scatter according to the λ^{-1} -law and which lie between the observer and the star. The second hypothesis is less probable than the first. H. L. B.

3676. Upper Limits for Densities and Temperatures in Stars. E. C. Stoner. *Roy. Astron. Soc., M.N.* 92. pp. 662-676, May, 1932.—It is shown that upper limits for the density and temperature of matter in stars are imposed by the properties of degenerate electron gas, on which the pressure of very dense matter mainly depends, but only provided the mass of the star is below a certain critical value. For polytropes $n = 3$ or $n = 3/2$ this critical mass is $0.92 \times (\text{mass of sun})$; there is then an upper limit for the central density of the order of $5 \times 10^8 \text{ gm./cm.}^3$ and, for the temperature, of $5 \times 10^9 \text{ C.}$ In all cases, however, the critical mass depends very largely on the mean molecular weight assumed. G. C. McV.

3677. Mean Ionisation in Stellar Atmospheres. H. N. Russell. *Mt. Wilson Observat. Contrib. No. 447. Astrophys. J.* 75. pp. 337-347, May, 1932.—The mean ionisation is calculated for a gas of the composition found by the writer for the solar atmosphere, over a range of temperature from 1700° to $25,000^\circ \text{ K.}$ and of electron pressure from 10^3 to 10^{-20} atmospheres. Tables are given for the metals alone, for hydrogen and for the assumed mixture of the two, with the reciprocal temperature and

electron pressure as arguments, and again with the gas pressure as second argument. Diagrams illustrate the effects of the successive ionisations of the constituents.

AUTHOR.

3678. Analysis of Stellar Structure. Part II. E. A. Milne. *Roy. Astron. Soc., M.N.* 92. pp. 611-643, May, 1932.—A further contribution [see also Abstract 1140 (1931)] to the complete solution of the problem: given the mass, M , and luminosity, L , of a spherical distribution of matter at high temperature, as well as the equations defining the phases (perfect gas, degenerate gas, etc.) of the matter, to determine the radii of possible steady-state configurations. A complete enumeration of the two-phase configurations with perfect-gas envelopes and degenerate-gas cores is now given for the case when the opacity is assumed to be constant, but not necessarily the same constant, in each phase. The equations of fit of the envelope on to the core are solved by a graphical method using tables of the solutions of Emden's equations for $n = 3$ and $n = 3/2$. The following properties are found for these models when the opacity of the core is negligibly small compared with that of the envelope: (1) there is a critical mass M_0 of the order of that of the sun; (2) for large L and $M > M_0$ there are pairs of configurations of different radii, in other cases there is only one configuration; (3) a nova phenomenon; (4) an approximate mass-luminosity law; (5) a phenomenon similar to Cepheid variation for maximum luminosity and any $M > M_0$. But all these models have radii much smaller than those observed in actual stars with the same M and L , except in the cases of white dwarfs. The general conclusion is that two-phase models, whilst reproducing most of the observed characteristics of actual stars, do not give the correct values for the radii.

G. C. McV.

3679. Theory of Stellar Structure. E. A. Milne. *Zeits. f. Astrophysik*, 4. pp. 75-117, March 4, 1932. In English. Abstract of three lectures delivered before the University of London.—A general discussion of stellar stability in which the absorption-coefficient and the energy-generation are both allowed to vary as arbitrary powers of temperature and pressure, and the stellar matter is allowed to exist in various phases (gaseous, degenerate, relativistic-degenerate, etc.). The problem is essentially one of boundary values; at the surface it involves the Schwarzschild-Hopf-Bronstein theorem, which materially alters the analysis as compared with all previous studies; at the centre the absence of a singularity may be assumed, but only when all possible phases have certainly been enumerated. One-phase and two-phase systems are discussed in detail. Several new dimensionless discriminants and characteristic lengths are obtained; the radius can be obtained plausibly, at least in order of magnitude, from these, and hence the other characteristics of the star. It appears probable that one-phase (i.e. gaseous) stars of mean molecular weight 2 would have a radius of about a parsec, a temperature of about one degree, and a density comparable with that of the cosmic cloud; it is concluded that actual stars always have at least one other phase near the centre.

R. d'E. A.

3680. Radii of Stellar Models. T. G. Cowling. *Zeits. f. Astrophysik*, 4. pp. 331-338, June 28, 1932.—Milne's recent suggestion [see preceding Abstract] that the radius of a perfect gas model of a star would be found to be of the order of one parsec if it satisfied the correct boundary conditions is discussed in the light of a numerical integration of Milne's

equations. This shows that besides Milne's models of radius one parsec there also exist certain models whose radii are of stellar order. AUTHOR.

3681. Stellar Structure. S. Rosseland. Zeits. f. Astrophysik, 4. pp. 255-264, May 30, 1932. In English.—This paper is concerned with the hydrostatic equilibrium of purely gaseous stars generating energy at a rate of $\epsilon_0 \rho^m T^n$ per unit mass and time, ϵ_0 , m and n being positive constants and ρ and T density and temperature. By numerical integration it is shown that a star of 10 solar masses built according to this model will contain a central core which is convectively unstable. The possible bearing of this fact on the interpretation of stellar variability is briefly discussed. AUTHOR.

3682. Stellar Models with Degenerate Nuclei. L. Biermann. Zeits. f. Astrophysik, 4. pp. 61-69, Feb. 2, 1932.—Various numerical integrations that have been performed, using the Kramers absorption coefficient, are studied in the light of Chandrasekhar's classification of the possible states of matter. The energy-generation is assumed to take place entirely in the stellar nucleus. It appears that models with a nucleus are usually only possible if the nucleus is relativistic-degenerate, and that it will then contain at most a small percentage of the star's mass, and be surrounded by a region in which currents will be maintained. R. d'E. A.

3683. Minimum Pressure of a Degenerate Electron Gas. E. C. Stoner. Roy. Astron. Soc., M.N. 92. pp. 651-662, May, 1932.—In astrophysical applications of degenerate-electron-gas theory, the densities are higher than those which justify the use of the degenerate-gas formula for the pressure, but lower than those required for the relativistically degenerate-gas formula. A formula for the pressure in terms of the density, at any intermediate stage between ordinary and relativistic degeneracy, is developed when the matter is at absolute zero. The effect of rise of temperature is negligible unless the temperature is very high. The constants κ_1 , κ_2 , which occur in the equations of state $P = \kappa_1 \rho^{5/3}$ and $P = \kappa_2 \rho^{4/3}$ are calculated numerically. G. C. McV.

3684. Extension of a Theorem of Stokes Relating to Fluid Stars. R. Wavre. Comptes Rendus, 194. pp. 1447-1449, April 25, 1932.—For an arbitrary motion of the fluid star it is shown that the external potential is completely determined when the free surface, total mass and surface accelerations are given. When the total mass is unknown, the potential is determined to the extent of an arbitrary potential function. G. C. McV.

3685. Tables of Solutions of Emden's Equation of Index 3/2. N. Fairclough. Roy. Astron. Soc., M.N. 92. pp. 644-651, May, 1932.—Numerical solutions are given of the equation $\psi'' + \frac{2}{\eta} \psi' = -\psi^{3/2}$, satisfying the initial conditions $-\eta_0^2 \psi'(\eta_0) = \omega_{3/2}$ and $\psi(\eta_0) = 0$ where η_0 and $\omega_{3/2}$ are prescribed constants. The tables include solutions of both "collapsed" and "centrally-condensed" type, as well as a recalculation of Emden's original solution. G. C. McV.

LIGHT.

3686. Kathode Projection and Optical Properties of Metal Films. A. de Gramont. *Rev. d'Optique*, 11. pp. 105-114, March, 1932.—The author has projected films of different metals from cathodes on sheets of glass, and has studied the reflection and transmission of these films with white light. The films were deposited in rarefied air, hydrogen and argon, and their stability was investigated. H. N. A.

3687. Peculiarities of Neutral Filters of Platinum. H. Kienle. *Zeits. f. Astrophysik*, 4. pp. 282-289, May 30, 1932.—The spectral transmissibility of neutral filters made by sputtering platinum depends not only on the thickness of the film of platinum, but also on the base on which it is deposited and on the method of covering the film. Canada balsam is shown to involve inconsistent behaviour. Filters made of platinum on glass are shown to be more nearly neutral than those on quartz. Reference is made to results previously obtained [see Abstract 3706 (1930)]. H. L. B.

3688. Light Absorption of Liquid Crystals. J. Fischer [with Vorländer]. *Zeits. f. phys. Chem.* 160, *Abt. A*, 1-2. pp. 101-115, May, 1932.—Measurements with a variety of substances which form liquid crystals show that the variation of absorption at a given wave-length changes abruptly with each change of phase, i.e., from solid to liquid-crystal and from the latter to true liquid. With 0.01-mm. films of optically inactive compounds it is necessary to use a wave-length greater than 4000 Å., but for cholesterin derivatives 0.5-mm. films may be studied by ultra-violet radiation. The absorption of liquid crystals resembles that of the liquid phase more than that of the solid phase, and the same is true of solutions of liquid crystals in inert solvents. H. F. G.

3689. Transmission of Light in Diffusing Media. R. F. Hanstock. *Optical Soc., Trans.* 33. 4. pp. 137-147; *Disc.*, 148-149, 1931-1932.—The transmission of light by thin films of diffusing material is investigated, a flicker photometer being used for this purpose. The intensity I of the diffuse light transmitted by a thin film in the direction which is normal to the surface is related to the film thickness x by the empirical equation $I/I = C [1 + ax + (ax)^2]$, where a is a constant depending on the opacity of the material of the film to diffuse light and C is approximately constant for all substances. The ability of a film to hide a contrasting background is proportional to the quantity $H = I/I$, complete hiding being attained for a value of H which is constant for all the materials investigated, namely a variety of white and coloured paints and papers. An accurate method of measuring the hiding power of such films is described. [See following Abstract.] AUTHOR.

3690. Hiding Power of Diffusing Media. T. Smith. *Optical Soc., Trans.* 33. 4. pp. 150-157; *Disc.*, 157-158, 1931-1932.—From theoretical considerations an expression is constructed as a numerical measure of the power of a sheet of a diffusing medium to hide the brightness contrasts of a surface on which it is laid. The dependence of this factor on the transmission and reflection factors of the sheet is exhibited and the effect of varying the thickness of the sheet is discussed. A comparison is made

of these theoretical results with published experimental observations. The definition adopted for the hiding power is $50/(\text{residual percentage contrast})$. The properties of all sheets may be expressed in terms of two constants, of which one is the reflection factor for an infinitely thick sheet, and the other is a factor for converting sheet thicknesses to the proper numerical scale. For a non-absorbing medium the absolute hiding power is $1 + 2\pi t$, and the reflection factor $\pi t/(1 + \pi t)$, where t is the thickness of the sheet. For an absorbing medium the absolute hiding power is $1 + \lambda \sinh 2kt + \lambda (\kappa - \lambda) (\cosh 2kt - 1)$ and the reflection factor $\lambda/(\kappa + \coth kt)$ where $\kappa = \cosh 2\epsilon$, $\lambda = \sinh 2\epsilon$, and the reflection factor or a very thick sheet is $\tanh \epsilon$. Expressions are given for the hiding power with respect to any assigned ground contrast. In experimental determinations the measurement of diffuse reflection factors in a photometric sphere is suggested. [See preceding Abstract.] AUTHOR.

3691. Effect of Spatial Induction on the Discrimination of Difference in Brightness. J. F. Shearer. *Phil. Mag.* 13. pp. 975-985, May, 1932.—The least perceptible difference of brightness, ΔI , between the two halves of a small test field ($2\frac{1}{2}^\circ$ angular subtense) was measured for a large range of brightnesses I of the test field and for four different brightnesses of a surround field subtending $22^\circ \times 15^\circ$ at the eye. For each surround, $I/\Delta I$ plotted against $\log I$, gave points to which an "exponential" curve could be fitted. As the brightness of the surround is raised the shape of the curve is not altered appreciably, but the maximum value of $I/\Delta I$ diminishes slightly, and is displaced towards higher values of $\log I$. Comparison is made with similar measurements by Lowry which are in agreement with those here given. The effect of subjecting the non-observing eye to different brightness levels, while measuring $I/\Delta I$ (zero surround), was found to be inappreciable, a result in opposition to that found by Kravkov in experiments on visual acuity. W. S. S.

3692. Anomalies of Visual Acuity in Relation to Stimulus Distance. E. Freeman. *J.O.S.A.* 22. pp. 285-292, May, 1932.—The author describes experiments which appear to show that the visual acuity expressed as an angle is greater when the objects resolved are at 300 cm. from the eye than when they are at 30 cm. The effect occurred for the whole range of intensities studied, but was greater at higher intensities. Use of an artificial pupil did not eliminate the anomaly, and experiments with a totally "uninformed" subject showed that the effect was not "psychological." The anomaly occurs with both light-adaptation and dark-adaptation. W. S. S.

3693. Photographic Method for the Measurement of Path-Difference of a Crystal Plate of Weak Birefringence in the Ultra-Violet. G. Szivessy and A. Dierkesmann. *Zeits. f. Krist.* 82. pp. 258-270, May, 1932.—An arrangement consisting of polariser, analyser, thin half-shadow quartz plate, quartz-fluorite lens system and camera. The crystal plate under test is mounted on a rotating table between the quartz plate and the polariser, and from the orientation of the specimen with respect to the half-shadow plate the path-difference is deduced. [See Abstract 3772 (1931).] F. I. G. R.

3694. Artificial Spherulites and Related Aggregates. H. W. Morse, C. H. Warren, and J. D. H. Donnay. *Am. J. Sci.* 23. pp. 421-439, May, 1932.—Perfect spherulites or related crystalline aggregates, VOL. XXXV.—A.—1932.

various "malformed" and aberrant forms, of over 100 slightly soluble substances have been obtained artificially by metathesis, aided by slow diffusion in jellies. Perfect spherules give, in parallel light, an interference pattern called the "spherulitic figure," somewhat similar to the figure obtained in convergent light with a uniaxial crystalline slice cut normal to the optic axis. A list of measurable properties of spherulites, and a non-mathematical explanation of their peculiar optical behaviour, are given. "Spherulitic birefringence" is defined in contradistinction to ordinary crystal birefringence. Some optical data for 67 substances are appended. [See following Abstract.] C. B. A.

3695. Spherulite Optics. H. W. Morse and J. D. H. Donnay. *Am. J. Sci.*, 23. pp. 440-461, May, 1932.—A mathematical investigation of the optical properties of spherulites. [See preceding Abstract.] C. B. A.

3696. Double and Complex Salts and Circular Dichroism. J. P. Mathieu. *Comptes Rendus*, 194. pp. 1727-1729, May 17, 1932.—When excess of a solution of sodium tartrate is added to one of a cobaltous salt rosettes of pale rose needles are formed, which, dried at 120°, consist of $\text{Na}_2\text{Co}(\text{C}_4\text{H}_4\text{O}_6)_2$, and behave as an ordinary double salt. If, however, to a mixture of equal volumes of twice-normal cobaltous nitrate and sodium tartrate 4M-NaOH is added until the precipitate first formed redissolves, and then slowly more NaOH, aq. a red transparent jelly forms, which on standing in a closed vessel changes to a readily oxidised solution, and deposits rose-coloured microscopic crystals (when dried at 120°) of $\text{Na}_2[\text{CoC}_4\text{H}_4\text{O}_6] \cdot n\text{H}_2\text{O}$. This behaves as a complex salt, probably $\text{Na}_2[\text{CoC}_4\text{H}_4\text{O}_6] \cdot n\text{H}_2\text{O}$. Solutions of both salts show similar absorption bands, but their optical activities are different; the rotatory dispersion of the double salt is only very slightly anomalous, that of the complex salt strongly so; this latter also shows marked circular dichroism. C. A. S.

3697. Optical Rotation and Chemical Constitution. M. Betti and P. Pratesi. *Accad. Lincei, Atti*, 15. pp. 509-513, April 3, 1932.—In the chloro- and bromo-benzoic aldehydes similar anomalies have been found in the optical rotatory power as were found in the dissociation constant. The *p*-bromobenzal derivative has a rotatory power of 348°, whereas the *p*-chloro-benzal derivative has a rotatory power of only 282°, showing that the bromine compound is more electronegative than the chlorine compound. E. E. F. d'A.

3698. Influence of Solvents and of Temperature on the Rotatory Powers and Dispersions of Active Substances. R. Lucas and (Miss) D. Biquard. *Comptes Rendus*, 194. pp. 1805-1806, May 23, 1932.—Gives the results obtained at different temperatures, using different solvents, with four active substances. H. N. A.

3699. Studies in Solvent Action and Rotatory Power. Parts III and IV. H. G. Rule and A. McLean. *Chem. Soc., J.* pp. 1400-1415, May, 1932.—In a previous communication [see Abstract 2652 (1931)] the rotatory power of *l*-menthyl methyl naphthalate in solvents derived from the same parent hydrocarbon was shown to be dependent upon the polarity and disposition of the substituent groups in the solvent molecule, the higher the polarity the lower the rotation. Part III now considers solvents which are mixtures of alcohols with benzene or hexane and a similar relationship is established. The depression in the rotatory power

when *l*-menthyl methyl naphthalate is dissolved in alkyl or aryl derivatives containing a given polar constituent becomes less pronounced as the molecular weight of the hydrocarbon rises. Steric hindrance offered to association between alcohol and ether results in the alcohol behaving more like a pure hydrocarbon and yielding a solution of high rotation. Part IV investigates the optical rotation of *l*-menthyl hydrogen naphthalate in polar and non-polar solvents, the above relationship being again established. The general conclusion is drawn that the rotatory power most characteristic of an optically active solute is exhibited when the substance is dissolved in a non-polar solvent such as benzene or CCl_4 . In aliphatic hydrocarbons like hexane there may be a tendency, even at high dilutions, for the active compound to exist in the associated state, with a consequent modification of the rotatory power. Solvents containing polar substituents may affect the rotation by themselves entering into combination or dipole association with the solute. In the latter case, the influence of monosubstituted derivatives of the same parent hydrocarbon, tends to be related to the dipole moments of the solvents. H. H. Ho.

3700. Variation with Thickness and Rôle of Multiple Reflections in the Magneto-Optical Effects in Thin Iron Films. M. Cau. *Comptes Rendus*, 194. pp. 1642-1644, May 9, and pp. 1807-1809, May 23, 1932.—This paper continues previous work [see Abstract 2716 (1929)], and contains calculations of the theoretical values of the magneto-optical rotation and ellipticity produced by iron films of different thickness deposited upon glass, which are placed normally to a magnetic field of 10 kilogauss, and traversed normally by a pencil of polarised light of wave-length $546\text{ m}\mu$. Account is taken of various superficial effects (*loc. cit.*) and of multiple reflection within the thin metal layer and establishes that the rôle of multiple reflections only becomes effective for very small thicknesses. The experimental results are in good agreement with the calculated data. H. H. Ho.

3701. Magnetic Rotation Spectrum and Heat of Dissociation of the Sodium Molecule. F. W. Loomis and R. E. Nussbaum. *Phys. Rev.* 40. pp. 380-386, May 1, 1932.—Wood's magnetic rotation spectrum of Na_2 had been extended by the method previously used with Li_2 and K_2 [see Abstract 1970 (1932)] to higher vibrational levels. This leaves a very short extrapolation to dissociation. The energy of dissociation of the normal molecule is $D_0 = 0.76 \pm 0.02$ volt, which is in good agreement with the best chemical data. AUTHORS.

3702. Magnetic Rotations of Liquid Mixtures. R. N. Mathur and A. N. Kapur. *Indian Journ. Phys.* 7. pp. 15-18, April 1, 1932.—The diamagnetism of some mixtures of organic liquids having been found by previous observers to be considerably different from that calculated from the proportions of the components, the authors have examined the rotations of the mixtures, chloroform-acetone, ether-chloroform, and ether-acetone, and find that for all proportions the observed rotations do not differ materially from the calculated rotations. [See Abstract 2803 (1931).] G. E. A.

3703. Variation of Faraday Effect with Concentration. P. K. Pillai. *Indian Journ. Phys.* 7. pp. 87-90, April 1, 1932.—Ten different concentrations of cerium nitrate in water were tested with respect to their magnetic rotatory power. The rotations when plotted against the con- VOL. XXXV.—A.—1932.

centrations gave a straight line, and the Verdet constants, when calculated by assuming that of water, gave a similar relation with the concentrations. The Verdet constants for wave-lengths near an absorption band show considerable anomalies with respect to concentration. [See also Abstract 3973 (1930).] G. E. A.

3704. Faraday Effect in Liquid Mixtures. K. Scharf. *Ann. d. Physik*, 13. 4. pp. 377-408, May 4, 1932.—The Verdet-Schönrock mixture rule for magnetic rotation is tested on binary mixtures of associating organic liquids, and deviations from it are found. On account of its dependence on refractive index, and thus on density, the Verdet constant of a liquid mixture cannot be treated as an additive quantity. The magnetic rotation "invariant" $D_0 = n\lambda^2/(n^2 + 2)^2$ (r = Verdet constant) is also found not to be additive in aqueous solutions of alcohol and acetone, although it is so in the system nitrobenzene-benzene. Nitrobenzene-alcohol and alcohol-benzene show slight divergences from additivity. These divergences are attributed to changes in the dispersion constants occurring in solutions and mixtures. C. B. A.

3705. Stroboscopic Method of Measuring Electric Birefringence. R. Lucas and M. Schwob. *Comptes Rendus*, 194. pp. 1729-1731, May 17, 1932.—A disc with six slits is rotated by a synchronous motor so connected with the illuminating lamp and the coil producing the electric field causing the birefringence that the lamp is most brilliant, a slit is open and the field is a maximum simultaneously. C. A. S.

3706. Design of Kerr Cells. W. D. Wright. *Phys. Soc., Proc.* 44. pp. 325-334; *Disc.*, 334-335, May 1, 1932.—The paper describes some principles that were employed in designing a Kerr cell for use in a television system. The volts/intensity characteristic of the cell is developed and the theory is extended to apply to the case when an optical bias is used. The chromatic effects obtained with high potentials are discussed and finally the treatment of the cell as an integral part of an optical system is given. It is shown that from this aspect the most efficient form of cell is one using shaped plates. The frequency-response is briefly discussed. AUTHOR.

3707. Nitrobenzene Kerr Cell. Kerr Constant of Nitrobenzene ($\lambda = 5461 \text{ \AA.}$). F. Hehlhans. *Phys. Zeits.* 33. pp. 378-382, May 1, 1932.—Previous work is first discussed [see Abstract 1590 (1932)] following which a description is given of the apparatus for evaluating the Kerr constant of highly purified nitrobenzene at 20° . $B = 3.86 \times 10^{-6}$ e.s.u. with a probable error of $\pm 0.9\%$. H. H. Ho.

3708. Spinterometer. A. Occhialini and L. Gallino. *Accad. Lincei, Atti*, 15. pp. 559-563, April 3, 1932.—A new type of spinterometer, designed to promote reproducible constancy of relation of the parts and to prevent variations arising from wear. The instrument is fitted with a double ocular to facilitate observations. The experimental results are exceedingly constant. A. D.

3709. Particle Size and Concentration in Opal Glasses. C. Dunbar. *Optical Soc., Trans.* 33. 3. p. 135, 1931-1932.—Describes a method of micrometric measurement using oil immersion and a magnification of about 5000 diameters. The measurement is made by shift of the mechanical stage of the microscope, the amount of the shift being measured by means of a Fabry-Perot interferometer system. The con-
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centration is found by focussing through a thickness of the opal glass which is large compared with the focal depth of the objective. The concentration found was of the order of 5×10^{10} per c.c., the diameter of a particle being of the order of 1μ . J. W. T. W.

3710. Examination of Very Flat Surfaces for Interferometry. M. Duffieux. *Rev. d'Optique*, 11. pp. 159-166, April, 1932.—The flattest optical surfaces such as are used in interferometer apparatus always present defects of flatness which are determined only with difficulty by ordinary methods of examination involving fringes produced by reflection. The surfaces considered are resilvered with a layer which is semi-transparent and then examined in pairs with the help of a specially constructed interferometer by a transmission method. A mercury vapour lamp is used and excellent definition of the fringes is obtained. The methodical displacement of the interferometer allows the tracing of the fringes in the air gap and thus of its thickness. Accidents of relief amounting to $\lambda/200$ (i.e., $3 m\mu$) can be detected. The errors introduced by the silvering can be avoided or disclosed. The individual topography of the two surfaces can be found by graphical methods. Surfaces studied by this procedure, however good their form, have a relief which is quite accidental and complicated in spite of its feeble amplitude. R. S. R.

3711. Method of Using a Large Rowland Grating, and a Study of its Defects. P. Lacroute. *Comptes Rendus*, 194. pp. 1803-1805, May 23, 1932.—As used by Rowland a grating does not give a very large amount of light. The author employs a method, which was rejected by Runge and Mannkopf because it does not give perfect astigmatism. It has, however, the advantage of increasing the amount of light in a marked degree, while it gives a rough astigmatism. The source is projected on the slit in the ordinary way, and a cylindrical lens is placed between the slit and the grating. Spectra five or ten times as luminous as those without the lens are thus obtained, and the Zeeman decompositions remain very sharp. Studies the "ghosts" observed with this arrangement. H. N. A.

3712. Theory of Concave Grating Spectrograph, Especially at Large Angles of Incidence. J. E. Mack, J. R. Stehn and B. Edlén. *J.O.S.A.* 22. pp. 245-264, May, 1932.—Extension of the theory of the concave grating shows the diffraction pattern for a spectral line to be different in shape from that for a plane grating. Rayleigh's definition of resolving power is generalised to allow of the computation of the resolving power in terms of an "effective width," i.e., the width of a plane grating having the same resolving power as the concave one in question. At grazing incidence this effective width is of the order of 1 cm. The optimum width of a grating is found—it is shown that the gratings ordinarily used in the past have been considerably wider than the optimum. It is shown that the reduction of the grating width to about the optimum eliminates the grazing incidence ghosts (differing from Rowland ghosts) which occur in the neighbourhood of strong lines in grazing incidence spectrographs. The grating spectrograph as a whole is also discussed. A. H.

3713. F/1.8 Quartz Monochromator-Spectrograph. J. W. Perry. *Optical Soc., Trans.* 33. 4. pp. 159-174; *Disc.*, 174-175, 1931-1932.—The circumstances in which large monochromators and spectrographs of especially high illuminating power are requisite are discussed

and the dependence of illuminating power and instrument efficiency upon the essential optical characteristics of such instruments is investigated. A description is given of a large instrument fulfilling the combined functions of monochromator and spectrograph, the relative aperture of which varies from $F/1.6$ at 0.185 to $F/2.0$ at 1.2μ , and records of performance are described. AUTHOR.

3714. Photometric Eyepiece for Visual Quantitative Spectrum Analysis. F. Twyman. *Optical Soc., Trans.* 33. 4. pp. 176-181; *Disc.*, 181, 1931-1932.—A new type of eyepiece is described whereby a spectrum is split into halves, a selected line of the one half being brought vertically above a selected line of the other. The intensity of the brighter line is then reduced by means of a neutral tint wedge until equality of the two intensities is obtained. The eyepiece is used in an analysis of some cadmium-lead alloys, an accuracy of some 11 % of the cadmium content being obtained. Of the error 7 % is due to irregularities of the wedge used. AUTHOR.

3715. Universal Spectrometer for the Infra-Red. A. H. Pfund. *J.O.S.A.* 22. pp. 281-284, May, 1932.—The instrument described is of the fixed-arm type. A beam of light from a narrow slit in a perforated plane gilded mirror passes to a concave mirror and is rendered parallel. It is reflected back to the plane mirror and thence to the prism. Another plane mirror, attached to a pivoted arm passing under the prism, with its distance from the pivot twice that from the prism, reflects the spectrum to another concave mirror which in turn focusses it upon a slit and thence on a thermopile or radiometer. Replacement of the prism by a wire grating or echelette requires only a few minutes. For a rock-salt prism the range of wave-lengths extending from 0.6μ to 13μ was as good as for the Wadsworth spectrometer. R. S. R.

3716. Measurement of Coherence Length with the Gehrke-Lau Multiplex-Interference Spectroscope. P. H. van Cittert. *Ann. d. Physik*, 13. 6. pp. 753-760, May 21, 1932.—Theoretical investigation shows that the multiplex-interferometer itself sets a limit, independent of the light source and wave-length, to the possibility of observation of interference fringes at high path difference. This limit is of the same order as that found experimentally by Lau [see Abstract 3774 (1931)]. C. B. A.

3717. Multiplex-Interference Spectroscope Compared with Other Types. E. Lau and E. Ritter. *Zeits. f. Physik*, 76. 3-4. pp. 190-200, May 31, 1932.—The multiplex interferometer is compared with other interference spectroscopes with regard to intensity measurements, dispersion and resolving power. Details of the adjustment of the instrument for high resolving power are given, and a photograph showing the resolution of Hg 5461 Å. is reproduced, the resolving power in this case being about 5,000,000. C. B. A.

3718. Photographic Action of Electrons. R. Whiddington and J. E. Taylor. *Leeds Philosoph. and Lit. Soc., Proc.* 2. pp. 264-266, Jan., 1932.—The law of blackening of a photographic film by electrons of speed within the region 50 to 300 volts has been studied quantitatively. The law is similar to that in the case of light, and is represented by the expression: $D = \gamma \log I t^p - i$, where D is the density of the plate, I is

the intensity of the light which has produced the blackening, t is the time of exposure, p is Schwarzschild's constant, γ is a constant for any one wave-length and diminishes for shorter wave-lengths, and i is the inertia of the plate. The constant i referring to the "threshold" of the film is the one most affected in the sensitising process of oiling the surface. The photographic effect for a given number of electrons falling on the film is independent of their energy within the region examined. H. H. Ho.

3719. Influence of Ag- and H-Ion Concentrations on the Sensitivity of Photographic Emulsions. B. H. Carroll and D. Hubbard. *Bureau of Standards, J. of Research*, 8. pp. 481-505, April, 1932.—The paper is introduced by discussions of previous experimental and theoretical work on Ag and H ions in emulsions, and description of experimental technique. These variables are taken up first according to their effects on after-ripening, and second according to their direct effects on sensitivity when changes in after-ripening are eliminated (in experiments after digestion). The rate of after-ripening increases with increasing Ag ion concentration and increasing pH; the corresponding effects on sensitivity are much larger than those produced by the direct effect of environment (after digestion). The combination of Ag ion with gelatin reduces the effect of excess silver. Illustrations are given for the distribution of excess bromide or silver in the emulsion with changing pH. The desensitising action of bromide (after digestion) is found to increase with increasing acidity; conversely, the effect of pH is dependent on the Ag ion concentration. Spectral sensitivity of the emulsions is found to be independent of H or Ag ion concentrations; these variables must, therefore, influence sensitivity through secondary reactions in latent image formation. Results are discussed in terms of a new concept of the adsorption of gelatin to AgBr, based on the "zwitterion" theory of ampholytes. L. V. C.

3720. Photographic Effect of Pressure. Ny Tsi-Ze and Chien Ling-Chao. *Comptes Rendus*, 194. pp. 1644-1646, May 9, 1932.—Poindexter's apparatus [see Abstract 1889 (1931)] has been employed for a further study of the effect of pressure upon a photographic emulsion during exposure, whereby it is established that the effect is greater for green than for blue-violet light, Wallace filters being used. For p greater than 200 kg./cm.², the rectilinear relation $E/E_0 = 1 + 0.00065 p$ is found to hold, E and E_0 being the respective effects under pressure and normally. H. H. Ho.

3721. Exposure Meters. J. H. Pledge. *Phot. J.* 72. pp. 206-215; *Disc.*, 215-216, May, 1932.—A detailed description of all such instruments, extant or superseded, classified as: (1) exposure tables; (2) actinometers; and (3) optical exposure meters (direct photometers). L. V. C.

3722. Optics of Photometric Measurements. T. Smith. *Phys. Soc., Proc.* 44. pp. 314-324, May 1, 1932.—The influence of the apertures which limit the light transmitted from the source to the photometer, and of the reflection and transmission coefficients of the specimen and apparatus used, including the source and the photometer themselves, on the quantities determinable from a photometric balance are considered. The way in which the apparatus is set up must take into account the precise information to be obtained. A general theory is given, which leads to the conclusion that in precise photometry the measurement of the light reflected in both directions, in addition to that transmitted, is

necessary when the properties of materials are being determined. A suitable experimental arrangement for making the measurements is described. The method of calculating these quantities from the observations is given, and numerical examples are included. AUTHOR.

3723. Phosphorescent Sulphides; Influence of Collisions of the Second Kind. M. Curie. *Comptes Rendus*, 194. pp. 1566-1568, May 2, 1932.—It is suggested that long duration phosphorescence is associated with collisions of the second kind—that outer electrons of atoms of a centre already excited suffer collisions of the second kind which may remove them altogether from the centre. It is further suggested that the photoelectric effect in phosphors is associated with these more or less free electrons. It is known that the photoelectric effect is greater with excited phosphors than with non-excited ones. J. E.

3724. Spectrum of Fluorescing Iodine. I. I. Agarbiceanu. *Comptes Rendus*, 194. pp. 1913-1914, May 30, 1932.—A preceding note showed that the spectrum of fluorescing iodine vapour contained anti-Stokes terms (-1) and (-2) [see Abstract 3244 (1932)]. It was there considered necessary to put $v'' = 4$ for the first series of the absorption spectrum of I_2 . These considerations are confirmed by a further examination of the other lines appearing on the plate. A corrected and extended list of lines is given together with these orders. J. E.

3725. Chemiluminescence of Amarin. S. S. Bhatnagar and K. B. Mathur. *Zeits. f. phys. Chem.* 159. *Abt.A.* 6. pp. 454-458, May, 1932.—In the reaction of an alcoholic solution of amarin with dissolved Br_2 , Cl_2 or H_2O_2 a weak luminescence is given with a short-wave limit at about 4500 Å. From this it is concluded that the luminescence is emitted in oxidation and that the heat of oxidation is 63 kcal.—in agreement with the value deduced from other facts, viz., 67.6 kcal. J. E.

3726. Sodium Vapour Flames. E. Horn, M. Polanyi and H. Sattler. *Zeits. f. phys. Chem.* 17. *Abt.B.* 2-3. pp. 220-232, May, 1932.—When halides of Cd or Zn are introduced into flames containing Na vapour, luminescence of the D lines is excited. The method of producing the flame is described, and the results of measurements of the light emission for various salts at different concentrations given. Various explanations are proposed. F. S.

3727. Luminescence of Glass and Fluorite. T. Lyman. *Phys. Rev.* 40. pp. 578-582, May 15, 1932.—In the first part of this paper a simple method for showing the relation between the absorption of light and the resulting luminescence in glass is described. The second part contains some observations on the luminescence of clear and coloured fluorites and of quartz in the extreme ultra-violet. In the case of clear colourless fluorite light on the short wave-length side of the absorption limit at 1230 Å. is responsible for luminescence in the visible and also in the ultra-violet. This ultra-violet luminescence seems to consist of two parts. In the first place, there is a rather strong, broad band extending from the neighbourhood of 2450 to 3810 Å. In the second there are sharp lines at 3812, 3144 and 3133 Å. AUTHOR.

3728. Absorption Spectra in the Region 600-900 Å. H. J. Henning. *Ann. d. Physik*, 13. 5. pp. 599-620, May 13, 1932.—Observations were made with a vacuum-grating spectrograph of 1 m. radius,

using the continuous spectrum of He observed by Hopfield [see Abstract 837 (1931)]. CO_2 , CO and H_2O were admitted to the instrument at various pressures to obtain their absorption. All of these molecules show discrete bands in this region and H_2O shows a continuous absorption corresponding to 12.4 volts. A second continuous region is attributed to predissociation. CO_2 shows a continuous spectrum at 12.0 volts. F. S.

3729. Absorption Measurements in the Ultra-Violet. H. Ley and B. Arends. *Zeits. f. phys. Chem.* 17. *Abt.B.* 2-3. pp. 177-219, May, 1932.—Measurements were made using either a quartz spectrograph or a fluorite apparatus [see Abstract 1847 (1930)] and employing either Henri or v. Winther's method. Organic acids are found to show a selective band at about 2040 Å., while carbonic acid is found to have a free frequency at about 1800 Å. Ammonia in hexane has a band at about 1920 Å. which varies in position with the compound. The influence of CO and NH_2 groups on the absorption of aliphatic ampholytes is also discussed. F. S.

3730. Ultra-Violet Absorption Spectra of Nitrates and Chromates at 20° K. H. Schaumann. *Zeits. f. Physik*, 76. 1-2. pp. 106-131, May 12, 1932.—The absorption spectra of nitrates of Na, K and Ba, and of chromate and bichromate of potassium, have been photographed in solution and in crystals at room-temperature and at 20° K., between 4200 and 2400 Å. In general the spectra of the crystals at room-temperature are shifted towards shorter wave-lengths, as compared with those of solutions, but in some cases in the opposite direction. At low temperatures the bands split up into a large number of single bands, which in all cases have a distance apart of $800 \text{ cm}^{-1} \pm 100$. A further splitting observed with KNO_3 is found to be connected with pleochroism in the crystal, and this is shown qualitatively to exist in polarised lights. At the same time, apparently in all cases, the splitting up of the bands is accompanied by a considerable decrease in the total absorption for the bands concerned.

H. N. A.

3731. Ultra-Violet Absorption Bands of Sodium Vapour. M. Kimura and Y. Uchida. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers*, No. 359. pp. 109-118, May, 1932. *In English*.—Using sodium vapour contained in an electrically-heated evacuated steel tube the region $\lambda 2700\text{--}\lambda 3470$ has been examined for absorption bands by means of a Hilger E1 spectrograph. Six band systems are found and the vibrational structures analysed, further evidence for the analysis being obtained from the emission spectrum. The dissociation products of the upper electronic states are determined. A. H.

3732. Absorption Band Spectra of Germanous Sulphide: Isotopic Constitution of Germanium. C. V. Shapiro, R. C. Gibbs and A. W. Laubengayer. *Phys. Rev.* 40. pp. 354-365, May 1, 1932.—Photographing the GeS absorption spectrum with a 6-ft. grating, two band systems (both degraded to the red) are found in the middle ultra-violet. The bands due to Ge^{74}S in the two systems are fitted by $\nu = 32889.5 + 374.99(v' + \frac{1}{2}) - 1.514(v' + \frac{1}{2})^2 - 575.80(v'' + \frac{1}{2}) + 1.80(v'' + \frac{1}{2})^2$ and $\nu = 38890.0 + 310.4(v' + \frac{1}{2}) - 1.35(v' + \frac{1}{2})^2 - 575.8(v'' + \frac{1}{2}) + 1.8(v'' + \frac{1}{2})^2$ respectively. No isotope analysis is possible for the further ultra-violet bands, but for the other system isotopes 70, 72, 74 and 76 are in evidence. The normal state of the molecule is found to have an energy of dissociation

of 5.64 volts, those for the two excited states being 2.84 and 2.17 volts respectively. A. H.

3733. Absorption Spectrum of Iodine Monochloride in the Near Infra-Red. O. Darbyshire. *Phys. Rev.* 40. pp. 366-379, May 1, 1932.—By employing a temperature of 400° C. and suitably adjusting the pressure it has been possible to photograph the ICl absorption spectrum in the region 6750-8770 Å., consisting of seven progressions for which $v'' = 1$ to 7. More reliable values for the vibrational and related constants of the ICl molecule are thus obtained. The dissociation energy for the normal state found by extrapolation from the lowest eight levels is some 5700 cm.⁻¹ units greater than the energy required to dissociate the molecule by raising it to the higher state and increasing the energy in that state, so that there is a crossing of the potential energy curves; the possible significance of this with regard to the products of dissociation from the lower state is discussed. Bands of the $v'' = 3, 4, 5$ progressions of the ICl³⁷ spectrum are identified and for them the isotopic shifts are opposite in sign to those of the higher v' members of the $v'' = 0$ progression previously recorded. A. H.

3734. Absorption Spectra of Solutions of Iodine in Organic Solvents. M. Chatelet. *Comptes Rendus*, 194. pp. 1809-1810, May 23, 1932.—The solutions employed were two component mixtures of benzene with acetone, ethyl acetate or chloroform (Group I), and carbon tetrachloride with benzene, acetone, ethylacetate or chloroform (Group II). The solutions were so varied that the amount of iodine per c.c. remained constant. For Group I, the absorption spectra indicated that the iodine was divided between the two solvents in proportion to their volumes in the mixture, whereas this regularity no longer held good for Group II. H. H. Ho.

3735. Absorption Spectra of Lignin Solutions. A. J. Stamm, J. Semb and E. E. Harris. *J. Phys. Chem.* 36. pp. 1574-1584, May, 1932.—The photographic method of Hilger and also a direct method in which the intensity of transmitted monochromatic light was measured with a thermopile were employed with satisfactory agreement. The hardwood lignins gave characteristic absorption bands with maxima at 2740 to 2760 Å., and the softwood at 2810 to 2850 Å. The different methods used for isolating lignin from wood had substantially no effect upon the absorption spectra. The lignin from partially chlorinated wood, or previously isolated lignin that was only partially chlorinated, when dissolved in aqueous sodium sulphite gave absorption bands that have extinction coefficients somewhat smaller than those of lignin solutions prepared from completely chlorinated wood or lignin. The data obtained are useful for the determination of the purity of lignins isolated by various processes. H. H. Ho.

3736. Absorption Spectrum of Mercury Vapour. H. Kuhn and K. Freudenberg. *Zeits. f. Physik*, 76. 1-2. pp. 38-54, May 12, 1932.—The absorption spectrum of mercury vapour and its alteration with pressure and temperature has been investigated to establish the nature of the initial state [see Abstract 855 (1932)]. The Koernicke measurement of the weakening of band 2540.3 Å. with rising temperature has been repeated, and the former value for the heat of dissociation of mercury (1.6 k.cal.) confirmed. It is found that the initial state is no true molecular state; but an impact

state of positive energy. Data are given for the course of the potential curve of the normal atoms, and the course of the absorption coefficients with wave-length has been measured. The Mrozowski data are found to be inaccurate. The course of the oscillation term differences of polarisation molecules, and the dimensional order of the primary oscillation quantum of mercury, has been theoretically estimated. *Erratum, ibid.*, 76. 7-8. p. 564, June 20, 1932. H. H. Ho.

3737. Nature of Light Absorption by Crystals and an Optical Method of Determining the Heat of Sublimation. M. Kimura. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No. 361. pp. 129-140, May, 1932. In English.*—The relation between absorption frequencies of a metal-halide in its crystalline and vapour states is considered. It is shown that the difference between a crystal absorption frequency and the corresponding vapour absorption frequency of the same substance gives an approximate value of the heat of sublimation of the substance. This relation is shown to be valid in the cases of thallium-, silver- and alkali-halides, and reveals the nature of the process accompanying the light absorption in a crystal. The relation is applied to an optical determination of the heats of sublimation of alkali-halides. AUTHOR.

3738. Energy Levels and Relation between Absorption Frequencies of the CdI_2 Molecule in the States of Vapour and Crystal. M. Kimura. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No. 362. pp. 141-149, May, 1932. In English.*—The energy levels of the cadmium iodide molecule concerning its absorption spectrum, and the emission of the Wieland band system of class II are considered and the dissociation products of such excited state molecules are determined. The heat of sublimation of the substance are calculated, and the absorption frequencies of the crystal are estimated. These are compared with the frequencies observed by H. Fesefeldt [see Abstract 464 (1931)] and the nature of the process accompanying the light absorption of the crystal is explained. AUTHOR.

3739. Absorption Spectra and Dissociation Products of Triatomic Molecules. M. Kimura. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No. 363. pp. 150-156, May, 1932. In English.*—The energies required to dissociate the molecules CO_2 , NO_2 , N_2O and H_2O in their various excited states are considered. These are compared with the absorption frequencies of these molecules in the extreme ultra-violet region studied by Leifson [see Abstract 1583 (1926)], and dissociation products resulting from the absorption by these molecules are suggested. AUTHOR.

3740. Absorption Spectra and Thermochemical Constants of Lead Halides. M. Kimura and Y. Uchida. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No. 364. pp. 157-165, May, 1932. In English.*—From the absorption frequencies of lead halides in their crystalline state and the heats of sublimation of these substances, positions of absorption bands of PbI_2 and $PbBr_2$ vapours are estimated. Absorption frequencies of vapours of these substances are experimentally determined and the dissociation products of various electronic excited molecules are suggested. The above estimation is found to be correct. The process accompanying the light absorption by these crystals is then explained. For $PbCl_2$, the heat of sublimation is estimated from absorption data.

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Various heats of dissociation of these molecules are determined from the spectroscopic data. AUTHORS.

3741. Absorption Spectra at Low Temperatures. L. B. Arnold, Jr., and G. B. Klisiakowsky. *Am. Chem. Soc., J.* 54. pp. 1713-1722, May, 1932.—An apparatus is described for studying the ultra-violet absorption spectra in solution at low temperatures. It is shown that aromatic rings are characterised by narrow absorption bands in solution at low temperatures, while the spectra of aliphatic groups remain diffuse. The mutual influence of the spectra of two such groups as the carbonyl and benzene rings extends through carbon chains not more than two atoms long. At greater distances in the molecule the spectra become entirely independent of each other. AUTHORS.

3742. Effect of Temperature on the Absorption Bands of Benzene and its Derivatives at Low Temperatures. A. H. Croup. *Phys. Rev.* 40. pp. 345-353, May 1, 1932.—The ultra-violet absorption spectra of benzene and the derivatives, *o*-, *m*- and *p*-dichlorobenzene, were investigated throughout the temperature range from -190°C . to 20°C . The behaviour of the spectra of the four compounds is very similar. They all show a number of unresolved major and minor absorption bands. Both the frequency and the intensity of these bands increase with a decrease of temperature. The temperature-frequency curves are all approximately represented by parabolic equations, except in the neighbourhood of their melting points. The frequency difference between the bands remain constant with temperature within the limits of the experiment and agree favourably with those found by other spectroscopic methods. If these frequency differences are due to the vibrational transitions within the molecule, this spectral shift cannot be accounted for on the basis of a change in the inner vibrational terms, as has previously been suggested. AUTHOR.

3743. Heat of Dissociation of Fluorine and the Latent Heat of Vaporisation of Lithium from Spectroscopic Data. M. S. Desai. *Roy. Soc., Proc.* 136. pp. 76-82, May 2, 1932.—The absorption spectra of vapours of NaF and KF have been determined; the absorption is continuous and begins at an ill-defined long wave-length limit as in the case of other alkali halides. By application of Born and Franck's development of Kratzer's theory of the diatomic molecule it is shown that for a fluoride MF, $\frac{1}{2}D_{F_2} = R - [Q + L_M - L_{MF}]$, where D_{F_2} is the heat of dissociation of F_2 , Q the heat of formation of MF (solid), and L_M and L_{MF} the latent heats of evaporation of M and MF, respectively; R , the heat required to dissociate 1 gm. atom each of M and F, is equal to $h\nu$, where ν is the long wave-length absorption limit. D_{F_2} is found from the measurements with NaF and KF to be 76 ± 2 k. cal. The latent heat of evaporation of lithium, obtained in a similar manner by study of the LiF absorption spectra, is approximately 29.4 k. cal. H. F. G.

3744. Modification of Residual-Ray Method for the Visible and Ultra-Violet Regions of the Spectrum. C. Schaefer. *Zeits. f. Physik*, 75. 11-12. pp. 687-694, May 6, 1932.—Details are given of the apparatus used to find the positions of strong selective reflection in the visible and ultra-violet regions of the spectrum. Many organic liquids are examined and the position of the characteristic wave-lengths approximately found.

In all cases sharper lines are obtained by reflection at a liquid-glass or liquid-quartz surface than at the surface liquid-air. H. M. B.

3745. Infra-Red Characteristic Frequencies of Alkali-Halide Crystals. R. B. Barnes. *Zeits. f. Physik*, 75, 11-12, pp. 723-734, May 6, 1932.—Fifteen kinds of crystal, prepared in thin films of 0.2 to 3 μ in thickness, are examined in the infra-red. Graphs are shown between the characteristic frequency and the atomic weight of the metallic ion, and in each case the frequency appears as a simple function of the atomic weight. The connection between the characteristic frequency, the transmission minimum, the reflection maximum and the residual-ray wave-length are discussed. In all cases, secondary maxima, of which the cause is unknown are found on the short-wave side of the chief maximum.

H. M. B.

3746. New Line as Standard of Wave-Length. A. Pérard. *Comptes Rendus*, 194, pp. 1633-1635, May 9, 1932.—By means of the Michelson interferometer comparisons have been made between the provisional standard red line of Cd and four Kr lines, and reasons are given at length for adopting $K_{\alpha 1}$ (5562.22576 Å.) as standard.

H. H. Ho.

3747. Spectroscopy and Valency. Part I. Periodic Groups of Atoms and Ions. C. H. D. Clark. *Leeds Philosoph. and Lit. Soc. Proc.* 2, pp. 336-346, April, 1932.—Discusses the classification of the elements according to spectroscopic ground states with a view to elucidating the problem of valency. Ions, and the rare earth elements, are also discussed.

A. H.

3748. Influence of Substitutions on the Frequency of Vibrations of Ethylenic Compounds. Method of Classification of the Radicals. M. Bourguet. *Comptes Rendus*, 194, pp. 1736-1739, May 17, 1932.—Groups in organic substances are associated with definite frequencies whose value is displaced according to the mode of attachment and to neighbouring substitutions. This work is a continuation of a previous note on an attempt to elucidate the laws of this displacement of the characteristic frequencies in ethylenic compounds [see Abstract 1253 (1932)]. The influence of different radicals attached to the double bond is considered. The variation in the frequency in the neighbourhood of 1600—by general agreement associated with $C = C$, gives an indication

of the force variation in the bond, since $\nu = \frac{1}{2\pi} \sqrt{\mu \left(\frac{1}{m_1} + \frac{1}{m_2} \right)}$. It appears that while the alcoholic radical increases the force, the so-called negative radicals CO_2H , C_6H_5 , CHO , Cl , Br diminish the force. Further, these radicals make themselves felt in the same sense though with less effect when they are attached to the neighbouring C of the double linkage. The same effects have been observed with di- and tri-substitutions in the ethylenic compounds.

J. E.

3749. First Spark Spectrum of Arsenic (AsII). A. S. Rao. *Phys. Soc., Proc.* 44, pp. 343-348, May 1, 1932.—The spectrum of arsenic has been examined under varying conditions of excitation, and lines belonging to the singly-ionised atom have been identified. Combinations between the deep terms of the singlet and triplet system of AsII have been discovered; about 70 lines have entered into the classification. A pro-

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visional term scheme, based on two members of the singlet series $5s^1P - mp^1D$, is set up. The largest term $4p^2P_0(\nu 162788)$ leads to an ionisation-potential of about 20.1 volts. [See Abstract 2747 (1929).]

AUTHOR.

3750. Band Spectrum of Nitrogen Sulphide. A. Fowler and C. J. Bakker. *Roy. Soc., Proc.* 136. pp. 28-36, May 2, 1932.—By passing uncondensed discharges through a tube containing sulphur vapour and nitrogen a band spectrum attributed to NS is obtained. The spectrum closely resembles the ultra-violet band spectrum of nitric oxide and appears in nearly the same region. It contains two systems of bands, corresponding with the γ and β bands of NO. In NS the doublet separations are larger, and the separations of successive bands smaller, than in NO.

H. F. G.

3751. Spectra of Rare Gases. Part II. E. Rasmussen. *Zeits. f. Physik*, 75. 11-12, pp. 695-704, May 6, 1932.—In continuation of earlier work [see Abstract 2432 (1932)], new terms have been added to the arc spectrum of A by means of which the deviations of d -terms from a Ritz formula have been related to corresponding deviations in the spectra of Kr and Xe.

F. S.

3752. Emission of the Yellow-Red Band Spectrum of Sodium. M. Kimura and Y. Uchida. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No. 360*. pp. 119-128, May, 1932. *In English*.—The yellow-red band spectrum of sodium emitted by heated sodium vapour when excited by h.t. discharges was photographed with a grating spectrograph having a moderate dispersion. This spectrum is found to be identical with certain selected parts of the absorption spectrum of Na_2 in the same spectral region. By the aid of the vibrational and rotational analysis of this absorption spectrum, the spectrum is explained as a complicated resonance spectrum of the sodium molecule excited by the absorption of D-lines, the positions and widths of line groups being correctly located. Thus, it is shown that the molecule would be excited by absorbing D-lines emitted by the vapour itself, but perhaps not by the collision of the second kind with excited Na atoms at ^2P state.

AUTHORS.

3753. Emission of the Auroral Green Light in the Night Sky. M. Kimura. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No. 365*. pp. 166-176, May, 1932. *In English*.—Four possible processes are considered by which oxygen in the atmosphere might be excited to ^1S -state atoms and ready for the emission of the auroral green line 5577. It is shown that, of these processes, the excitation of ^1D -state oxygen atoms into ^1S -state by the collision with ^2D -state nitrogen atoms, both being produced by the photo-dissociation of the solar radiation during the daytime, will be the main reaction generating parent atoms for the emission of the line 5577. An observed intensity of the auroral green line and its unfading character during night are explained by the above consideration. An explanation of the actual occurrence of the forbidden transition $^1S \rightarrow ^1D$ is also given.

AUTHOR.

3754. Emission Bands and Rays in the Night Sky Spectrum. J. Dufay. *Comptes Rendus*, 194. pp. 1898-1900, May 30, 1932.—An earlier investigation [see Abstract 1327 (1932)] has been continued and the results are extended to April, 1932. It was found that, (1) the green ray

has become much less intense since the end of Nov., 1931; (2) the continuous spectrum in the blue and violet has disappeared and only the Fraunhofer lines remain; (3) by special methods the green, yellow and feebler red rays were located. Slipher found these rays in 1929. They were feebler in March and early April. The red rays appeared to belong to the aurora. The yellow rays appeared to be of interstellar origin, but the variations of intensity indicated an atmospheric origin. R. S. R.

3755. Hyperfine Structure of Mercury. Part V. K. Murakawa. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No. 366. pp. 177-190, May, 1932. In English.*—The hyperfine structure of mercury lines in the ultra-violet region is investigated. All lines are, without contradiction, interpreted by assuming the nuclear moment of $I = 0, 1/2, 3/2$ for even isotopes, Hg^{199} , Hg^{201} respectively and the intensity-rules for the hyperfine structure multiplet. In the case of $\lambda 5461$ ($6^3\text{P}_2-7^3\text{S}_1$), each of the even isotopes emits only about 74 % of the theoretical intensity. AUTHOR.

3756. Hyperfine Structure of Lead. K. Murakawa. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No. 367. pp. 191-204, May, 1932. In English.*—All observed hyperfine structure of the lead spectrum can be interpreted by assigning the nuclear moments $I = 0, 1/2, 0$ to Pb^{208} , Pb^{207} and Pb^{206} respectively. The spectroscopic data give as the ratios of mixtures of ordinary lead isotopes the values: $\text{Pb}^{208} : \text{Pb}^{207} : \text{Pb}^{206} = 47.7 : 25.9 : 26.4$. In all the arc lines the even isotopes are displaced. In the case of Pb II term, Pb^{208} can lie lower as well as higher than Pb^{206} . AUTHOR.

3757. Isotope Displacement Effect of Hg, Tl and Pb. H. Schüller and E. G. Jones. *Zeits. f. Physik, 76. 1-2. pp. 14-18, May 12, 1932.*—The appearance of an isotope displacement effect has been observed by various investigators in the atomic lines of about eight elements. The displacements are appreciable in the case of light elements at the beginning of the periodic table and are very large in the case of the heavy elements at the end of the periodic table but are negligibly small for elements in the middle of the table. It is established that the displacement effect is in the same direction for the Hg II lines as for the Hg I lines, the terms of the lightest isotope lying the deepest. The relative positions of the isotope terms from Hg^{198} to Pb^{208} are given in a table. J. E. K.

3758. Theoretical Intensities in the Hydrogen Molecular Spectrum. W. C. Price. *Roy. Soc., Proc. 136. pp. 264-271, May 2, 1932.*—Theoretical intensities in the band spectrum of hydrogen are calculated for sets of lines differing only in their lower vibrational quantum number. Several types of eigenfunctions are used. The agreement with experimental is good and some theoretical points are illustrated by means of the eigenfunctions. H. H. Ho.

3759. Diminution in Intensity in Forbidden Series. S. Sambursky. *Zeits. f. Physik, 76. 1-2. pp. 132-134, May 12, 1932.*—Shows that the abnormally slow drop in the intensity of the forbidden series, $2^2\text{P}-m^2\text{P}$, of sodium can be explained on the assumption that forced dipole radiation is present. H. N. A.

3760. Origin of Forbidden Lines in the Spectrum of HgII. S. Sambursky. *Zeits. f. Physik, 76. 3-4. pp. 266-267, May 31, 1932.*—A few comments and suggestions regarding the line $2814.9 \text{ \AA}$. observed by VOL. XXXV.—A.—1932.

Paschen in the glow discharge of a hollowed cathode [see Abstract 3068 (1929)] and other lines observed by Naudé and Déjardin. J. J. S.

3761. Pressure Shift and Broadening of Spectral Lines. H. Margenau. *Phys. Rev.* 40. pp. 387-408, May 1, 1932.—The pressure shift of spectral lines, unexplained by the usual theories of pressure broadening, is treated on the basis of a theory which considers the perturbations produced by neighbouring atoms on the two states between which transitions occur. The calculation is directly applicable only to absorption lines, but its consequences are qualitatively correct for emission lines as well. Details are worked out mainly for the shift of $\lambda 2537$ of Hg in foreign gases, and are compared with the experimental data of Fuchtbauer, Joos and Dinkelacker. A red shift results whose magnitude agrees well with observations. The main results of the theory are: the shift is proportional to the density of the perturbing gas; it is usually to the red, but may, under certain conditions be to shorter wave-lengths; a dependence of the shift on the temperature exists, but is slight at ordinary temperatures; the "standard deviation" of frequencies within the broadened line is proportional to the square root of the density of the perturbing gas. J. E. K.

3762. Quantum Analysis of the Rotational Structure of the First Positive Bands of Nitrogen (N_2). S. M. Naudé. *Roy. Soc., Proc.* 136. pp. 114-144, May 2, 1932.—The emission spectrum of the first positive nitrogen (N_2) bands has been obtained by means of a powerful discharge in pure nitrogen in a water-cooled tube. The bands have been photographed in the third order spectrum of a 21-ft. concave grating having a dispersion of $0.7 \text{ \AA. per mm.}$ The bands examined are 5-2 (6705 $\text{\AA.}$) and 6-3 (6623 $\text{\AA.}$). Each band consists of three groups of nine branches of which three in each group are prominent. The structure agrees with a ${}^3\pi \rightarrow {}^3\Sigma$ transition, the ${}^3\pi$ state probably conforming to Hund's case (a) for the lower J values and passing to case (b) for higher J values. From the Λ doubling, it is concluded that the ${}^3\pi$ state is normal. The consecutive lines of the branches show alternating intensities in the ratio 2:1 approximately, indicating that the nitrogen nucleus has unit internal angular momentum. The rotational levels of the Σ state having odd K values have greater statistical weight and thus the ${}^3\Sigma$ state is either ${}^3\Sigma_u^-$ or ${}^3\Sigma_g^+$. The spin fine structure of the ${}^3\Sigma$ state agrees closely with Kramers' theory if $e'' = -0.433$ and $\gamma'' = -0.003$. The molecular constants have the values: $B''_0 = 1.440 \text{ cm.}^{-1}$; $\alpha''_0 = 0.013 \text{ cm.}^{-1}$; $\tau''_0 = 1.289 \times 10^{-8} \text{ cm.}$; $D''_0 = -5.5 \times 10^{-6} \text{ cm.}$; $B'_0 \approx 1.66 \text{ cm.}^{-1}$; $\alpha'_0 = 0.023 \text{ cm.}^{-1}$; $\tau'_0 \approx 1.20 \times 10^{-8} \text{ cm.}$; $D'_0 = -6.2 \times 10^{-1} \text{ cm.}^{-1}$. J. S. G. T.

3763. Calculation of Potential Curves for Diatomic Molecules with Help of Spectral Terms. O. Klein. *Zeits. f. Physik.* 76. 3-4. pp. 226-235, May 31, 1932.—The problem of the determination of the potential energy of the nucleus in the case of a diatomic molecule from the knowledge of the energy as function of the radial action variables and of the impulse moment is made to depend on the solution of two Abel integral equations. Hence an expression is obtained suitable for numerical calculation. Hereby the spectral terms are to be exhibited according to Kramers' process by means of "half" quantum numbers. The known dependence

of the Hamiltonian function on the impulse moment has as consequence certain conditions which the term scheme must satisfy. J. J. S.

3764. Equilibrium between Matter and Radiation. Joan Y. Placinteanu. *Accad. Lincei, Atti*, 15, pp. 681-685, April 17, 1932. In French.—Using a statistical distribution function, due to Levi-Civita, appropriate to a system of particles of variable mass, the author derives the statistical distribution of photons in interaction with matter taking account of the transformation of material mass into radiation. For the number of particles in unit volume the result obtained is $n = 6\pi^2(kT/hc)^3$, which is the same as found by Eddington by other methods. The calculation yields incidentally the value $m_0 = 2kT/c^2$ for the rest mass of the photon. W. S. S.

3765. Theory of Radiation. C. G. Darwin. *Roy. Soc., Proc.* 136, pp. 36-52, May 2, 1932.—The methods of wave mechanics are applied to the single photon, as far as possible by the process which has been successful in the case of the electron. The usual real form of electromagnetic waves implies the existence of two waves of equal amplitude, but of positive and negative energy and momentum, and it is proposed that the latter should be rejected. The polarisation of light is connected with its angular momentum in a manner resembling the spin of the electron. The separation of angular momentum into an intrinsic part and an external part due to motion of the centre of gravity is shown to be artificial and dynamically meaningless; such division is not experimentally possible, and the intrinsic momentum of a photon is unobservable. The radiation of an atom is discussed, and the perturbation of the photon by an electron is considered; the energy of perturbation is derived for the case of Thomson scattering.

H. F. G.

3766. Evidence for a Spinning Photon. Part I. Intensity Relations in the Raman Spectrum of Hydrogen. S. Bhagavantam. *Indian Journ. Phys.* 7, pp. 107-138, May 15, 1932.—Measurements have been made of the intensity and polarisation of the lines in the Raman spectrum of hydrogen. The results when compared with those calculated from quantum mechanics by Manneback show a beautiful agreement in respect of the relative intensity (both vertical and horizontal components) of the different lines in the P and R branches. A striking disagreement, however, appears in respect of the intensities of the horizontal components of the P and R branches when compared with the horizontal component of the Q branch, the actual intensities of the former being much smaller in relation to the latter than the values given by theory. The results appear to indicate a definite failure of the accepted scheme of quantum mechanics. A suggestion is made as to the cause of the failure, namely, that in quantum mechanics, the intrinsic spin of the photon has not been properly taken into account. A revised calculation on a modified basis gives results in agreement with experiment. AUTHOR.

3767. Intensity Measurements in the Raman Spectrum. A. Carrelli and J. J. Went. *Zeits. f. Physik*, 76, 3-4, pp. 236-249, May 31, 1932.—Quantitative intensity measurements in the Raman spectrum showed that Raman bands instead of Raman lines must be spoken of and that each Raman band has a characteristic form. A comparison of the width of the Raman bands with infra-red bands was made. A polarisation examination showed the various degrees of polarisation of the middle and

the edge of the Raman bands. With CCl_4 no continuum was observed, but this occurred with C_6H_6 . By an intensity comparison of the Raman bands with the Rayleigh light it was possible to determine the proportion of the scattering moments of the molecules for the displaced and undisplaced frequency. J. J. S.

3768. Light Absorption, the Raman Effect and the Motions of Electrons in Gases. V. A. Bailey. *Phil. Mag.* 13. pp. 993-1000, May, 1932.—Measurements by Townsend, the author and others, give the mean percentage energy ($100\Delta E/E$) lost by an electron in collision with a molecule, as a function of E , the mean energy of agitation of the electron, when electrons are driven through a gas at a given pressure by an electric field. Curves of $100\Delta E/E$ against E (in volts) for eight gases are here plotted and for five of them (CO_2 , CO , N_2O , NH_3 , C_2H_4) the maximum of the curve corresponds to an energy value E for which the appropriate frequency ν ($h\nu = Ee$), is close to that of the radiation in the infra-red region which is absorbed most strongly by the molecule. Similarly the energies corresponding to the Raman line frequency shifts are associated with characteristic changes of shape of the curves. Two final sections deal mainly with Franck's views on the loss of energy of slow electrons in gases. W. S. S.

3769. Raman Spectra of Aniline Derivatives. G. B. Bonino and P. Cella. *Accad. Lincei, Atti*, 15. pp. 568-572, April 3, 1932.—Previous work had indicated that the band $\text{C} = \text{N}$ in aniline gave in the Raman spectrum a band $1430\text{--}1450\text{ cm}^{-1}$. But this is, in the Raman spectrum of aniline, confused with lines due to CH_2 . The authors have instead of aniline tried several derivatives of aniline containing no CH_2 . In each case the results came out clearly. A. D.

3770. Raman Spectrum of Δ_2 Dihydronaphthalene. G. B. Bonino and P. Cella. *Accad. Lincei, Atti*, 15. pp. 572-576, April 3, 1932.—Note on, and discussion of, certain doubled lines observed in this spectrum. [For previous work see Abstract 4202 (1931).] A. D.

3771. Raman Spectra of Aqueous Solutions of NaOH and KOH. J. R. Nielsen. *Zeits. f. Physik*, 76. 1-2. pp. 56-59, May 12, 1932.—Photometer curves are given of the spectra obtained when solutions of NaOH and KOH are irradiated with He line $3888\text{ \AA}$. Both solutions gave the same line, $3603 \pm 4\text{ cm}^{-1}$, which is attributed to the OH ion. A. C. M.

3772. Raman Spectra of Cyclic Hydrocarbons. E. Canals, M. Godchot and Germaine Cauquill. *Comptes Rendus*, 194. pp. 1574-1577, May 2, 1932.—The Raman lines are given for cyclo-pentane, -hexane, -heptane and -octane, and their methyl derivatives. It is concluded that the spectra of these compounds are very similar. The number of lines in the region appropriate to the C—C bond decreases as the number of C atoms in the ring increases. The line 1440 is almost invariable, and is taken as due to the $-\text{CH}_2$ group. Introduction of the methyl group has the effect of decreasing the frequency of the strong line about 800 cm^{-1} . This effect is greater the less the number of C atoms in the ring. A. C. M.

3773. Raman Effect in Crystalline Phosphates and Silicates. Luminescence of Zircon. H. Nisi. *Phys. Math. Soc., Japan, Proc.* 14. pp. 214-229, May, 1932. In English.—The Raman spectra of apatite, VOL. XXXV.—A.—1932.

beryllonite, phenacite, topaz, beryl, danbarite, zircon and tourmaline were examined in detail. On the whole, phosphates give the Raman lines, as is expected from their structures, but the frequency shift of the inactive line of the PO_4 -group varies from crystal to crystal. In orthosilicates, the frequency shift of the inactive line of the SiO_4 -group increases with the valency of the metal ion and is subject to fluctuation. In other silicates, the frequency shift of the corresponding line seems to decrease, when the O atom of tetrahedral groups is shared between two Si atoms. In the case of topaz, it is confirmed that interchanging the directions of observation and illumination does not affect the relative intensities of Raman lines, which are generally influenced by both directions. Topaz, beryl and tourmaline give one or two Raman lines of large frequency shifts. Besides Raman lines, zircon exhibits a characteristic luminescence, consisting of many line-like bands, most of which are in the blue and green-yellow regions.

AUTHOR.

3774. Study of Isomeric Change by Means of the Raman Effect.

H. Conrad-Billroth, K. W. F. Kohlrausch and A. Pongratz. *Zeits. f. Phys. Chem.* 17. *Abt. B.* 2-3. pp. 233-240, May, 1932.—By the use of a special spectrograph, necessitating an exposure of only 2 min., it has been possible to record the change of the Raman spectrum of *trans*-dibromoethylene during the transition into the *cis-trans* equilibrium mixture. The velocity coefficient of the transition has been calculated, and indicates that the ratio between the numbers of molecules of the *cis*- and *trans*-forms at equilibrium is 4 : 1.

H. F. G.

3775. Nature of X-Rays. J. A. Wasatjerna. *Roy. Soc., Proc.* 136.

pp. 233-242, May 2, 1932.—The author considers the effect of assuming that energy is localised both in space and time. Combining this with the results of an experiment performed by the author, in which the statistical variations of the ionisation current produced by X-rays were investigated, three conclusions are reached, *vis.*, that radiation consists of energy elements $h\nu$; that absorption is brought about by distinct elementary processes; and that interference phenomena are made up of elementary processes governed by chance.

J. E. R. C.

3776. Determination of the Spectral Composition of X-Rays from Filtration Data. L. Silberstein. *J.O.S.A.* 22. pp. 265-280, May, 1932.—The author gives an approximate and practicable method of deducing the spectral composition of X-rays from their absorption data.

The intensity, $I(x)$, of all wave-lengths transmitted by a filter is measured for different filter thicknesses, x . In the small range λ to $\lambda + d\lambda$, the exponential law holds so that $I(x) = \int_0^x e^{-\mu f(\lambda)} d\lambda$. The problem is, given $I(x)$ as a function of x , and the absorption coefficient, μ , as a function of λ , to find $f(\lambda)$. Writing $f(\lambda)d\lambda/d\mu = \phi(\mu)$, and $I(x) = \int_0^x e^{-\mu} \phi(\mu) d\mu$, the author shows how the determination of a small number of values of $f(\lambda)$ may be effected. The range of perceptible radiation is divided into a number, n , of equal parts, $\Delta\lambda$, so that $I(x) = \Delta\lambda \cdot \sum_{i=1}^n e^{-\mu_i} f(\lambda_i)$ approxi-

mately. Substitution of the observed values of $I(x)$, μ and x lead to a set of n linear equations for as many values of $f(\lambda)$. Reasonable estimates are obtained of the intensities in the corresponding ranges for $n=3$ or 4. The method has also been modified to take account of the fact that the results of some transmission measurements are expressed in terms of the

thickness of the pre-filter. The author adds in a note that he has obtained a rigorous solution of the integral equation which is in course of publication.

J. E. R. C.

3777. Anomaly in Absorption of X-Rays by Lead at 210 kV. M. E. Nahmias. *Comptes Rendus*, 194. pp. 1911-1912, May 30, 1932.—On plotting the coefficient of absorption of lead against the voltage from 104 to 600 kV, the anomalous increase for 204 and 210 kV observed by Jaeger [see Abstract 3494 (1931)] is confirmed. It is attributed to a level in the lead nucleus excited directly or by resonance by radiation of about 210 kV.

C. A. S.

3778. Origin of the X-Ray Non-Diagram Lines in the K Series. M. Sawada. *Kyoto Coll. Sci., Mem.* 15. pp. 43-56, March, 1932. In English.—To establish a scheme for the X-ray non-diagram lines (frequently called "spark lines" or "satellites"), the author assumed two-electron jumps in a doubly-ionised atom obeying the Heisenberg selection rule for the quantum number l . The $\frac{v}{R}$ values were computed on this hypothesis and compared with the experimental data. The results arrived at, which seem to account for the origin of these lines, are:

Origin		Non-Diagram Line	Origin		Non-Diagram Line
Initial State	Final State		Initial State	Final State	
KL _I	L _I M _{II} , III	K β'''	KM _I	M _I M _{II} , III	K β'''
KL _{II} , III	L _{II} , III M _{II} , III	K β''	KL _{II} , III	L _I M _{IV} , V	K β' (or K β_2)
KM _{II} , III	M _I , M _{IV} , V	K β''	KL _{II} , III	L _I M _I	K $\beta\eta$ (or K β_4)

The intensity of these lines, except those of K β'' , was estimated from the experimental values of the lines of the L series, and was found in close agreement qualitatively. The term multiplicities, and the effect of chemical combination, are also discussed. It is of interest to note that the scheme of the non-diagram lines K α_1^1 , α_3 , α_4 , α_5 , α_6 , etc., can be included in KL_I — L_{II}, III and KL_{II}, III — L_{II}², III by the experimental rules of the transition probability obtained in this paper, although the author cannot calculate the $\frac{v}{R}$ values in the (LS) coupling. Hence the result of Langer (*Phys. Rev.* 37. p. 457, 1931) concerning the origin of the non-diagram line of the K α group was included in the present scheme. A. D.

3779. Shape of an X-Ray Line. A. Hoyt. *Phys. Rev.* 40. pp. 477-483, May 15, 1932.—An X-ray emission line as measured by the double-crystal spectrometer ("antiparallel" position) can be represented very accurately by means of a simple empirical formula. Some uses for the formula are (1) location of background under the K α doublet, (2) the calculation of the separation of close components from measured points used in the empirical formula. This formula appears to be a function of a very useful type since it is also a good representation of rocking curves obtained in the "parallel" position of the spectrometer. A search for theoretical justification of this type of formula has brought to light the

curious result that although the application of the Dirac quantum theory of the radiation field yields a formula of the same type, the maximum ordinate predicted is independent of the spontaneous transition probability; whereas, certain experimental work indicates that the maximum ordinate is a good measure of the line intensity. This is very disturbing since the assumption is usually made that the line intensity is proportional to this Einstein coefficient of spontaneous transition. AUTHOR.

3780. M-Series in Ultra-Soft X-Rays. J. A. Prins and A. J. Takens. *Zeits. f. Physik*, 75, 11-12, pp. 741-745, May 6, 1932.—Plane-grating measurements have been made of the M-series lines emitted from elements, Zr (40) to Sb (51) to supplement crystal measurements made by van der Tuuk and Lindberg for elements of atomic number down to Ba (56), and a grating measurement by Thibaud on Mo (42). The apparatus is described in an earlier paper [see Abstract 3490 (1931)]. Only one strong line $M\zeta(M_{iv}, v, N_{ii}, iii)$ was found. This line obeys Moseley's law. No trace was found of $M\eta(M_{ii}, iii, N_{iv}, v)$ which was reported for the elements investigated by Lindberg, but, instead, some weak lines appeared which are attributed to transitions within the M shell. J. E. R. C.

3781. Atomic Scattering Power of Iron for Various X-Ray Wave-Lengths. A. J. Bradley and R. A. H. Hope. *Roy. Soc., Proc.* 136, pp. 272-288, May 2, 1932.—An experimental investigation is described of the atomic scattering factor of Fe using X-rays of different wave-lengths. Powder photographs of the alloy FeAl were made with Mo, Cu, Fe, Co and Cr radiations, and the intensities of the lines were measured photometrically. The reflections are of two types, Fe + Al and Fe - Al, from which relative f curves for Fe and Al are deduced. By reducing the Al f curve to the same scale as Hartree's f curve for Al, and introducing a temperature factor, the observations were made absolute. The Fe f values for each radiation are compared with the f values calculated by James and Brindley using the Thomas method. The f values for Cu, Co and Fe radiations are considerably less than the Thomas values, the difference in f for two radiations being almost independent of the angle of reflection. The f values fall in the sequence: Mo and Cr, Cu, Fe, Co. The value for Cu is about 0.5 units, for Fe about 1.5 and for Co about 3 units below that of Mo and Cr. The results indicate that away from the absorption edge the Thomas formula is applicable to Fe, but in the neighbourhood of the absorption edge, the scattering power falls off. The effect is very important at large angles where the f value for Fe is, in proportion, much more seriously diminished than at small angles.

H. H. Ho.

3782. Temperature and the Compton Effect of Sylvine. G. E. M. Jauncey and G. G. Harvey. *Phys. Rev.* 40, pp. 329-334, May 1, 1932.—From the theory of the diffuse scattering of X-rays by single crystals it appears that the ratio of the intensity of the incoherent to that of the total scattering at a given angle should be a function of the temperature. Accordingly X-rays of wave-length 0.40 Å. were scattered from sylvine at temperatures of 300° and 90° K. Aluminium was transferred from the primary to the scattered beam and from the observed change of absorption coefficient of the X-rays the above ratio was calculated. It was found that this ratio increased as the temperature decreased. AUTHORS.

RADIOACTIVITY.

3783. Radioactivity of Atmospheric Precipitates. J. A. Priebsch. *Gerlands Beitr. z. Geophys.* 36. 2-3. pp. 304-318, 1932. In German.—Thirty-three experiments were carried out in the Tyrol to determine the amount of radioactivity in rain and melted snow. The radioactive substances were precipitated by BaSO_4 and investigated by an α -ray electroscope. Radium and sometimes thorium products were present. The ratio N/M of the radium emanation and N'/M of the thorium emanation to the amount M of rain or snow was calculated. It was found to be smaller for rain than for snow, but the type of rain was immaterial. Theoretical considerations of the radioactive elements in the atmosphere and their deposition on drops of moisture is in agreement with the results obtained practically. H. M. B.

3784. Radioactivity of Potassium. D. Bocciarelli. *Accad. Lincei, Atti*, 15. pp. 686-693, April 17, 1932.—Measurements of the energy of the β -ray emission of potassium by a magnetic method are described. A preparation of potassium (KCl) was spread on a cylindrical band (7.2 cm. dia.) and a Geiger-Müller counter (1.5 cm. dia.) was placed coaxially inside the band. This apparatus, in a container maintained at low pressure (4 cm. Hg), was placed between the poles of an electromagnet with the lines of force parallel to the cylinder axis. The experiment consisted in counting the number of impulses to the counter per sec. (I) with various values of the magnetic field (H) which deflects the emitted β -rays and prevents their entry into the counter tube. The shape of the curve relating I and H , for the case of emission of homogeneous β -rays of any given velocity, could be computed. The actual curve obtained with potassium was complex and indicated the existence of two β -ray bands, one extending to a velocity of about 0.83 c., the other of much greater hardness. The latter has not been observed previously, although recent work on the γ -rays of potassium suggests its existence. W. S. S.

3785. Radioactivity of the Second Order, Artificially Induced. G. Reboul. *Comptes Rendus*, 194. pp. 1733-1735, May 17, 1932.—The author gives a summary of the results he has obtained with semi-conducting cells. The exposure of certain bodies to these cells gives them the property of impressing photographic plates and of influencing the electroscope. It is only insulators or bad conductors which can be thus activated. The gases which surround the cellule are also activated. Highly polished bodies activate badly. Metals, even in powder, do not activate at all. The action on the photographic plate requires exposures of from 12 to 48 hours. The cellules or the gases which surround them emit a very absorbable radiation; this acts upon the atoms of the insulator to be activated, and disturbs their electrical equilibrium, to which they return with a certain slowness. This return is accompanied by the emission of very absorbable radiations. The range of phenomena is of the nature of a radioactivity with wave-lengths of some hundreds of Angströms, and with energy-quantas of some tenths of a volt, and with correspondingly very small electron-velocities. A. D.

3786. Radon Content of Soil Gas. H. G. Botset and P. Weaver. *Physics*, 2. pp. 376-385, May, 1932.—An electroscope and technique for measuring the radon content of soil gas are described. Measurements were made to answer several questions regarding the radon content of soil gas. It was found that there is no systematic increase of radon content with depth of penetration into a soil, that soil formations appear to have more or less characteristic radon contents, that high radon content of a soil gas is not necessarily an indication of the presence of a fault and *vice versa*; and finally it is found that there is great local variation of radon content of soil gases. AUTHORS.

3787. Determination of Actinium in Uranium Minerals. Ellen Gleditsch and E. Foyen. *Comptes Rendus*, 194. pp. 1571-1572, May 2, 1932.—The actinium-uranium ratio has been determined (a) by extraction of the actinium, and (b) by precipitating protoactinium with tantalum; the radioactivities being measured with a Wulff electrometer. The ratios thus determined from broeggerite (from Raade) average 2.7 : 100, those from Cornish pitchblende 3.3 : 199, the probable error being $\pm 10\%$. [See following Abstract.] C. A. S.

3788. Actinium-Uranium Ratio in Cleveite. Ellen Gleditsch and S. Klemetsen. *Comptes Rendus*, 194. pp. 1731-1732, May 17, 1932.—The Ac : U ratio in cleveite from Aust-Agder, Norway, the age of which according to the RaG : U ratio is 10^8 years, determined as previously described [see preceding Abstract] averages 3.2 : 100, with a probable error of 10% . C. A. S.

3789. Inhomogeneity of Radium-Barium Salts of High Activity. F. Béhounek and O. Koblic. *Phys. Zeits.* 33. pp. 376-378, May 1, 1932.—The author describes experiments designed to investigate an apparent inhomogeneity in the strength of strong radioactive preparations. Large amounts of known weights were subdivided and then separately measured by their γ -radiation effects. The results are tabulated and large differences of activity are exhibited. The results are ascribed to inhomogeneity in formation of the mixed crystals. J. E. R. C.

3790. Electrolytic Deposition of Polonium on Metals. M. Haüssinsky. *Comptes Rendus*, 194. pp. 1917-1919, May 30, 1932.—Using previous methods [see Abstract 2463 (1932)] the critical potentials (in volts relative to the calomel electrode) of the polonium deposit on cathodes of (rolled unless otherwise stated) Pt, Au, Au (beaten), Cu, Ag, Sn and Ni are respectively (figures in brackets denote the normality of the solution of NaOH): -0.20 (0.82); -0.27 (0.75); -0.23 (0.75); -0.40 (0.75); -0.43 (0.72) and -0.39 (0.39); -0.65 (0.72); -0.89 (0.75), indicating that probably the polonium is hydrolysed, and, in the form of PoO_3 , acts as a depolariser. In an acid medium (0.23 N nitric acid) with Ag cathode the critical potential is $+0.36$ volt. C. A. S.

3791. Photography of Artificial Disintegration Collisions, and Accuracy of Angle Determinations. P. M. S. Blackett and D. S. Lees. *Roy. Soc., Proc.* 136. pp. 325-348, May 2, 1932.—By means of the author's automatic apparatus [see Abstracts 2522 and 3367 (1929)] and a source of $\text{ThB} + \text{C}$, (a) 750,000 tracks in a mixture of $50 \text{ A} + 10 \text{ O}_2 + 40 \text{ H}_2$ and (b) 350,000 in one of $50 \text{ N}_2 + 45 \text{ H}_2 + 5 \text{ O}_2$ were photographed. In (a) two inelastic collisions were observed, certainly not due to disintegration

of A, but probably of N_2 present as impurity; in (b) two collisions similar to those previously observed. The measurements of these four and of five previously obtained are discussed. The mean energy loss deduced from 8 of the tracks is $(1.27 \pm 0.13) \times 10^6$ volts. One track indicated $\pm 0.94 \times 10^6$ volts, but no reliance is placed thereon, and it is concluded that the α -particle is always bound into an energy level 1.27×10^6 volts higher than that from which the proton is ejected. The errors in the measurement of ϕ and θ , the directions of the α -particle and of the struck nucleus, and of ψ and ω , those of the proton and new nucleus, are respectively $13'-24'$, $13'-48'$, $25'$ and $50'$. C. A. S.

3792. Effect of α -Rays on the Passage of Electricity through Crystals. G. Jaffé. *Phys. Zeits.* 33, pp. 393-399, May 15, 1932.—The author has carried through a series of experiments using thin sheets of mica and others of quartz. These show that in both cases the passage of electricity through the crystals is distinctly affected by α -rays. The observed effects with mica, and a field intensity of 15,000 volts/cm., is of the same order of magnitude as the influence action of the α -ray charges. With quartz it is distinctly larger. The effect appears to be a surface one, perhaps an alteration in the stationary equilibrium in the polarisation layers; for it diminishes with increased layer thickness, and is not proportional to the square root of the intensity but as a rough first approximation to the intensity itself. It is proposed to treat the theory elsewhere. H. N. A.

3793. Retardation of α -Rays in Air and Bethe's Theory. G. Mano. *Comptes Rendus*, 194, pp. 1813-1815, May 23, 1932.—In a previous note [see Abstract 3313 (1932)] the author has shown that, using the α -rays of ThC' in air, there is a difference of the order of 25 % between the experimental result and that calculated from Bethe's equation, if the value of E given by Bethe is employed. Blackett has already shown that a correct value can be obtained from Bethe's equation by taking a suitable value for E, and the author finds that this is the case for the α -rays of ThC' in air if E is 1.47×10^{-10} ergs, or 92 electron volts. An explanation is given of these facts in terms of the ranges of the groups of α -rays involved. H. N. A.

3794. Absolute Velocities of Principal Groups of α -Particles. S. Rosenblum and G. Dupouy. *Comptes Rendus*, 194, pp. 1919-1921, May 30, 1932.—Using an improved focalisation method [see Abstract 1302 (1931)], which is described and gives results correct to $\pm 1/1000$, the following velocities (in 10^9 cm./sec.) of α -particles have been determined: from ThC' 2.054₄, RaC' 1.921₈, AcC₄ 1.784₆, AcC₄₁ 1.737₈, ThC₄ 1.705₈, Po 1.596₈, RaA 1.698₂. C. A. S.

3795. Resonance Penetration of α -Particles into the Aluminium Nucleus. K. Diebner and H. Pose. *Zeits. f. Physik*, 75, 11-12, pp. 753-762, May 6, 1932.—The authors have repeated the work of Pose on the subject, under altered experimental conditions. They have found that, in the case of the shortest H-ray group observed when Al is bombarded with Po α -rays, the range and yield of protons vary with the primary energy. The two longer range groups are produced only by characteristic primary energies, and thus exhibit the behaviour which is to be expected from resonance penetration of α -rays into the Al nucleus. H. N. A.

3796. Ranges of α -Particles from the Radioactive Emanations and A-Products and from Polonium. W. B. Lewis and C. E. Wynn-Williams. *Roy. Soc., Proc.* 136. pp. 349-363, May 2, 1932.—The following determinations of the above ranges have been made by the previously described method [see Abstract 1277 (1932)]. Corrected values of some previously made are added:

Origin of α -Particles.	Range in cm. of Air at 760 mm. and 15° C.		Straggling Coefficient ρ , in mm.	Velocity, V , Relative to V_0 .	Energy in electron-volts $\times 10^{-6}$.
	Mean.	Extrapolated.			
An (short) ..	5.203	5.262	0.81	0.916 ₇	6.45 ₃
An (long) ..	5.655	5.718	0.87	0.941 ₂	6.80 ₄
AcA	6.420	6.491	0.96	0.979 ₃	7.36 ₇
Tn	4.967	5.023	0.78	0.903 ₂	6.26 ₅
ThA	5.601	5.664	0.86	0.938 ₄	6.76 ₄
Rn	4.014	4.060	0.65	0.842 ₄	5.44 ₀
RaA	4.620	4.673	0.73	0.882 ₃	5.97 ₈
Po	3.805	3.848	0.62	0.827 ₄	5.25 ₇
AcC (short) ..	4.947	5.003	0.78	0.902 ₀	6.24 ₀
AcC (long) ..	5.392	5.453	0.83	0.927 ₂	6.60 ₃
AcC'	6.518	6.590	0.97	0.983 ₈	7.43 ₆
ThC (mean) ..	4.693	4.746	0.74	0.886 ₃	6.03 ₀
ThC'	8.533	8.623	1.20	1.069 ₃	8.78 ₈
RaC'	6.870	6.945	1.02	1.000 ₀	7.68 ₃

Extrapolated range is deduced from mean range by deducting $(0.8\rho - 0.06)$ mm. Velocities are calculated by the formula $V/V_0 = \Delta V/V_0 + (R/R_0)^{1/3}$, where V_0 and R_0 refer to α -particles from RaC'. A new curve is given relating $\Delta V/V_0$ to range, showing the departure from Geiger's law $V^3 = kR$. C. A. S.

3797. Dispersion of Neutrons from Beryllium and Production of Recoil Nuclei from Lithium. M. de Broglie and L. Leprince-Ringuet. *Comptes Rendus*, 194. pp. 1616-1617, May 9, 1932.—Neutrons resulting from the action of α -particles from radon on beryllium are strongly dispersed on passing through matter, e.g., lead, paraffin or potassium chloride, with production of strongly ionising nuclei, but with no greater production of any one kind of recoil nuclei. Neutrons capable of producing similar recoil nuclei are also formed, though in much smaller number, by the action of α -particles from radon on lithium [see Abstract 1658 (1932) and following Abstract]. C. A. S.

3798. Theory of Diffusion-Coefficient of Absorption of and Ionisation by Neutrons. J. L. Destouches. *Comptes Rendus*, 194. pp. 1909-1911, May 30, 1932.—By aid of Schrödinger's equations, expressions for the diffusion of neutrons by a heavy nucleus are deduced [see preceding Abstract], and also their coefficient of absorption, and hence k , the coefficient of field, $0.8 - 1.7 \times 10^{13}$ [see Abstract 2470 (1932) and following Abstract], loss of energy after traversing a given path, and the ionisation, showing this last to be negligible. Results agree satisfactorily with those of experiment. C. A. S.

3799. Penetrating Power of Radiation (Neutrons) Produced from Beryllium by α -Particles. J. Thibaud and F. D. la Tour. *Comptes Rendus*, 194, pp. 1647-1649, May 9, 1932.—The absorption in lead of neutrons projected from beryllium by α -particles from radon is complex. The curve $\log I_0/x$ (x = thickness) is strongly convex to the x axis. The coefficient of absorption, μ_x , decreases from 0.20 for $x = 1$ cm. to 0.065 for $x = 20$ cm., which indicates a further decrease in μ_x and that some neutrons will penetrate 50 cm. of lead [see Abstract 2469 (1932)]. Similar progressive filtration is indicated where neutrons, after passing through 4.4 cm. of lead, traverse Al, Si, S, Fe, Zn, Sn, Sb, Hg, Pb, ZnO, KNO₃ or KBr. The thicknesses absorbing half of such neutrons are of Al 5.5, Si 8, S 10, Fe 6-9, Hg 6 and Pb 5.5 cm., the absorption curves in all cases resembling that for lead. Light elements, e.g., Si, S, Fe, absorb per atom slightly less than lead. These results point to neutrons being projected with very varying velocities, and that they collide with atomic nuclei only when very close, e.g., within 5×10^{-13} for lead. [See Abstract 1658 (1932) and preceding Abstract.] **Erratum**, *ibid.*, p. 1868, May 23, 1932. C. A. S.

3800. The Neutron and the Element 0. R. Swinne. *Zeits. f. techn. Physik*, 13, 6, pp. 279-282, 1932.—The author gives an account of the evidence for the existence of the neutron and discusses the properties of the gas of atomic number 0 and atomic weight 1 which would be formed from it. An extensive Bibliography accompanies the paper. J. E. R. C.

3801. Association of γ -Rays with the α -Particle Groups of ThoriumC. C. D. Ellis. *Roy. Soc. Proc.* 136, pp. 396-406, May 2, 1932.—By a device whereby the recoil atoms of ThC'' derived from ThB+C with but little ThB+C served as source the magnetic spectrum of the resultant β -rays was determined, and the origins of the various lines ascertained. The energies of the γ -rays deduced therefrom indicate that the γ -rays known to be emitted as the result of the disintegration of either ThC or ThC'' actually do arise from ThC as required by Gamow's theory. C. A. S.

3802. Origin of γ -Rays from Actinium Emanation. E. Rutherford and B. V. Bowden. *Roy. Soc., Proc.* 136, pp. 407-412, May 2, 1932.—The authors use the complex α -particle groups from actinium emanation to produce evidence in favour of the view that the γ -radiation is produced by α -particle transitions. The energy of the γ -rays emitted is determined from their absorption in lead and agrees, within experimental error, with the difference between the energies of the two α -particle groups. J. E. R. C.

3803. Artificial Production of Nuclear γ -Radiation. H. C. Webster. *Roy. Soc., Proc.* 136, pp. 428-453, May 2, 1932.—The author discusses his discovery of the production of γ -radiation from various light elements by the impact of α -particles. The following elements gave positive results: Li, Be, B, F, Na, Mg and Al, whereas H, C, N, Ni, Cu and Sn gave negative results. A high-pressure ionisation chamber and a Geiger-Müller tube counter were employed and considerations governing their use are discussed. The energies of the emitted γ -radiation were determined from the absorption coefficients in lead, iron and aluminium, and range from 8×10^6 e.v. for Be to 0.5×10^6 e.v. for Na. The efficiency of production was investigated, and ranges from 0.5 quanta per 10^6 α -particles. VOL. XXXV.—A.—1932.

for Mg to 30 quanta for Be. The dependence of this efficiency upon the range of the α -particles is also discussed. A discussion of the processes responsible for the emission is given, and three methods are suggested, viz., capture of α -particle without proton emission, a secondary process following proton emission and an inelastic collision without capture.

J. E. R. C.

3804. Scattering of Short Wave-Length γ -Radiation. Lise Meitner and H. H. Hupfeld. *Zeits. f. Physik*, 75. 11-12. pp. 705-715, May 6, 1932.—Describes an experiment designed to find out if the differences between the values of the Klein-Nishina formula and the actual scattering coefficients are related to differences in the distribution of wave-lengths in the scattered radiation. RaC γ -radiation filtered through 3 cm. of lead was scattered through 90° . When iron is used as the scatterer the Klein-Nishina formula holds, and the scattered radiation is homogeneous. When lead is used as scatterer the Klein-Nishina formula does not hold, and the scattered radiation is non-homogeneous. There is a component, the wave-length of which is identical with that of the primary γ -radiation. This result agrees with the authors' assumption that the deviation from the Klein-Nishina formula is caused by an extra scattering in the atomic nuclei, which takes place without alteration of wave-length, as in the case of the Rayleigh scattering. H. N. A.

3805. Charge of Recoil Atoms of Radium D. M. Zyw. *Acta Physica Polonica*, 1. 1-2. pp. 259-269, 1932. *Summary in English*.—Using as source a platinum wire coated with RaB + C, Wood and Makower's method of determining the charge of recoil atoms by their behaviour in a magnetic field [see Abstract 78 (1916)] was repeated with a higher vacuum and a field of 12,000 gauss. The results indicate that the recoil atoms leave the wire uncharged if initially on the surface, but that atoms due to decay of parent atoms in deeper layers (having penetrated there owing to recoil of RaB from RaA) acquire a positive charge by collision with atoms of the wire, thus agreeing with Wertenstein [see Abstract 203 (1916)] but disagreeing with McGee [see Abstract 2020 (1932)]. C. A. S.

3806. Photographic Measurement of Absorption Coefficients of γ -Rays from Ra (B+C). J. S. Rogers. *Phys. Soc., Proc.* 44. pp. 349-366; *Disc.* 367, May 1, 1932.—In continuation of earlier work [see Abstract 1945 (1931)] in which the photographic action of γ -rays was examined, the absorption of the γ -rays from radium (B+C) filtered by 1.6 cm. of lead has been measured by a photographic method. With this lead filter the absorption is exponential. The absorption μ_e per electron for the lighter elements is found to be constant, in accordance with the Klein-Nishina formula; and the value, 1.56×10^{-25} , corresponds to a wave-length of 7.0 x.u. The increase of μ_e for the heavier elements in excess of this is found to vary as Z^3 , so that the additional absorption is assumed to be due to the photoelectric effect. It has been found that, by assuming the photoelectric term to vary as $\lambda^{3.2}$, an approximate agreement is obtained with the absorption of short X-rays. The intensity of the main γ -rays in the radium (B+C) spectrum after they have passed through 1.6 cm. of lead is calculated by assuming the $\gamma^{3.2}$ law, and it is shown that the intensities are not in contradiction to an effective wave-length of 7.0 x.u. It is shown that the use of limiting channels between the source and absorbers causes scattered, softened γ -rays to be superposed on the main beam.

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3807. Spherical Shell Method of Determining the Thermal Conductivity of a Thermal Insulator. S. E. Green. *Phys. Soc., Proc.* 44. pp. 295-312; *Disc.*, 312-313, May 1, 1932.—The spherical shell method of determining thermal conductivity has been applied to a thermal insulator in a system of comparatively small dimensions, the outer diameter of each of the shells employed being roughly 10 cm. Sulphur was selected as the material under test, and the spherical shells were cast in a brass mould. The supply of heat to the centre of the system was maintained electrically, a power-supply of 2 watts producing a temperature-drop of approximately 10° C. across the specimen. The range of temperature covered by the experiments was from 5° to 85° C. The results obtained are compared with those derived for sulphur by other observers. AUTHOR.

3808. Problem in Diffusion or Heat Flow for a Solid in Contact with a Fluid. R. E. Langer. *Tohoku Math. J.* 35. pp. 260-275, May, 1932.—The problem considered is that of a right cylindrical solid with plane ends, the lateral surface being impervious. The initial distribution of temperature (or concentration) is constant across any cross-section, and depends only on the longitudinal coordinate x . A liquid, the temperature or concentration of which is at all times independent of position, is brought into contact with one end of the cylinder at time $t = 0$. The other end may be subject to various boundary conditions. The peculiarity of the problem is that the coefficients of the Fourier type of series, to which the solution is reduced, have to satisfy two equations, one for all x between 0 and 1, and another for $x = 1$ (the junction between solid and liquid); the limit of the first condition as x tends to 1 is not identical with the second condition, which holds actually at $x = 1$. Thus the trigonometrical series has a discontinuity at this point. This leads to the coefficients being indeterminable by the usual method, but a method is developed in which the orthogonal relation $\int Q_s(x)Q_t(x)dx = 0$ when $s \neq t$, is replaced by $\int Q_s(x)Q_t(x)dx = -\sigma Q_s(1)Q_t(1)$. Here Q_s, Q_t are functions of x , and are solutions of the differential equation $d^2Q/dx^2 = \lambda^2 Q(x)$, whilst σ and λ are constants. J. H. A.

3809. Thermal Diffusivity of Nickel. R. H. Frazier. *Phys. Rev.* 40. pp. 592-595, May 15, 1932.—Results are given of tests for determining with precision the thermal diffusivity of a specimen of nickel having nearly the same chemical analysis as the one for which results and method of experimental procedure were presented in a former paper [see Abstract 2903 (1932)]. The overall probable error is shown to be about 0.06 %. The results and conditions of the tests are discussed in comparison with those for the former specimens. AUTHOR.

3810. Energy Exchanges between Molecules. P. S. H. Henry. *Cambridge Phil. Soc., Proc.* 28. pp. 249-255, April, 1932.—There is a marked disagreement between the specific heats at high temperatures of the diatomic gases as found by sound velocity measurements and those calculated from theoretical considerations. In the derivation of the Planck formula for the vibrational specific heat it appears that the only assumption open to question is that a state of equilibrium exists, i.e., that the gas is always

in a steady state when the sound is passing through it. Kneser has shown that there is a lag in the transfer of energy between the degrees of freedom of the CO_2 molecules greater than is given by classical mechanics. Assuming that this is also the case with other gases such as oxygen and nitrogen, the author gives a simple derivation of the effect of such a lag in the energy transfer in explaining the want of agreement between theoretical and experimental results. One method of investigating the matter would be to photograph the ultra-violet absorption spectrum (of oxygen) as it is escaping from a cylinder at high pressure. An attempt is to be made to carry out this experiment. T. B.

3811. Exchange of Energy between Monatomic Gases and Solid Surfaces. C. Zener. *Phys. Rev.* 40. pp. 335-339, May 1, 1932.—The accommodation coefficient, α , is calculated for a solid surface with respect to an inert gas. The repulsive energy of gas and surface atoms is taken to be of the reasonable form $Ce^{-r/a}$. All the normal coordinates of the solid are considered. Agreement is found with the available experimental data. The dependence of α upon temperature is given primarily by the factor $(U - U_0)/T$, where U is the internal energy of the solid.

AUTHOR.

3812. Surface Convection and Variation of Temperature near a Hot Surface. L. A. Ramdas and S. L. Malurkar. *Indian Journ. Phys.* 7. pp. 1-13, April 1, 1932.—Laboratory experiments were made to test the validity of the formula given earlier [see Abstract 2326 (1932)]. The nature of turbulence near a hot surface is shown and photographed for (1) the mirage image of a glass rod, (2) steam and (3) smoke from S and NH_4Cl . The up-currents of hot air and to a less extent the down-currents of colder air are illustrated. A series of vortices exists across the upper surface of the plate but with practically no turbulence below it. Temperature measurements above and below the plate are discussed. Above the plate in a skin layer up to 10 mm. and a surface layer up to 20 or 30 cm. the former equation is confirmed. For the skin layer $\alpha = 4.2$, and for the surface layer $\alpha = 0.29$, an abrupt change occurring between the layers. Surface turbulence is least intense in the skin layer. It is hoped to show that in the first mm. the skin layer falls off to a quiet boundary layer in which extremely low heat conductivity probably prevails.

R. S. R.

3813. New Method of Obtaining Radiation Constant. H. J. v. Massow. *Zeits. f. techn. Physik*, 13. 6. pp. 283-285, 1932.—An apparatus is described which can be used for measuring Stefan's constant for any surface. It is first calibrated by using materials of which the constant is known. Graphs show the relation between the constant and the temperature of the surface for different temperatures of the surroundings. A table of constants for ten new surfaces is given. H. M. B.

3814. Bolometers, Thermopiles and Mirrors used in Direction-Finding by Infra-Red Rays. G. Gresky. *Zeits. f. Instrumentenk.* 52. pp. 225-229, May, 1932.—A parabolic mirror is used to concentrate the infra-red rays from various directions in turn on a thermopile or bolometer at the focus of the mirror, and by this means objects (icebergs, etc.) may be located. The paper discusses the characteristics desirable in the receiver (thermopile or bolometer) and the mirror, and quotes observations of the sensitivity of a number of actual receivers, as well as the intensifying

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factors of a number of parabolic mirrors. Consideration is also given to the galvanometer and the rest of the detecting system. J. H. A.

3815. Vacuum Calorimeter for High Temperatures. L. G. Carpenter and T. F. Harle. *Phys. Soc., Proc.* 44. pp. 383-399; *Disc.*, 399, May 1, 1932.—A form of the platinum-thermometer type of vacuum calorimeter has been developed which is suitable for the determination of true specific heats at high temperatures, since it is constructed without any organic insulating materials. The design is novel in that the heat is transferred from the platinum coil to the calorimeter by radiation. The general principles of vacuum calorimetry are discussed and applied to the design of the present calorimeter, and a full description of the constructional details and experimental procedure is given. AUTHORS.

3816. Lowering of Eutectic Points. E. Cornec and H. Muller. *Comptes Rendus*, 194. pp. 1735-1736, May 17, 1932.—A study of the lowering of the eutectic point in an ice-KNO₃ mixture by the addition of organic compounds or of neutral mineral salts. The method permits an easy verification of the formula of salts. HENZEL, H. J. *Quod* A. D.

3817. Atomic Heat of Bismuth at Higher Temperatures. L. G. Carpenter and T. F. Harle. *Roy. Soc., Proc.* 136. pp. 243-250, May 2, 1932.—The measurements were carried out by means of a vacuum calorimeter of special design, capable of determining true specific heats up to at least 500° C. The range covered is from room-temperature to 370° C. In the immediate neighbourhood of the melting point (271° C.) there is a very large increase in the specific heat of the solid, attributed to the small amount of impurity (0.014 atomic %) known to be present. In the solid the value of C_p , the atomic heat at constant volume, exceeds 3R at all temperatures above about -10° C., and this is attributed in the main to the effect of anharmonic atomic vibrations, as the effect seems to be too large to be due to the heat capacity of free electrons. The atomic heat of the liquid decreases with increase of temperature. L. G. C.

3818. Heat Capacity and Entropy of Thallous Nitrate from 17° to 300° Abs.: Entropy and Free Energy of Nitrate Ion. W. M. Latimer and J. E. Ahlberg. *Am. Chem. Soc., J.* 54. pp. 1900-1904, May, 1932.—The molar entropy of thallous nitrate is calculated to be 38.1 at 298.1° K., and that of the nitrate ion 36.9, which is probably accurate to within 1. The earlier value 35.3, is probably inaccurate, owing to errors in the data used to calculate the entropy of the Ba ion. The free energy of the nitrate ion is calculated to be -26,700 cal., which agrees well with the value -26,500 cal. given by Lewis and Randall. For the entropy of the nitrite ion, the value 24.0 is calculated. T. H. P.

3819. New Hair-Type Humidity Control. M. C. Marsh. *Journ. Sci. Instruments*, 9. pp. 153-157, May, 1932.—A simple, robust hair-type humidity control instrument and a suitable relay board are described. The relays are fitted with a device which eliminates "hammering." AUTHOR.

3820. Conception of Relative Humidity at High Temperatures. H. Ebert. *Zeits. f. Physik*. 76. 3-4. pp. 163-171, May 31, 1932.—The author considers what effect the departure of water vapour from the ideal gas state will have upon the definition of relative humidity. A number of curves and tables show the difference between calculated and observed humidity values. It is shown that at high temperatures the usual definition. XXXV.—A.—1932.

tion of relative humidity introduces difficulties and alternative definitions are discussed. J. E. R. C.

3821. General Vapour-Pressure Apparatus. R. Mohr. *Phys. Zeits.* 33. pp. 419-420, May 15, 1932.—Describes a simple form of glass apparatus which can be adapted for the demonstration and even the measurement of the vapour-pressure as a function of temperature. In addition, measurements can be made of the condensation of saturated vapour on isothermal increase of pressure, the orthobaric density can be measured, and the truth of Dalton's law can be examined. J. H. A.

3822. Vapour-Pressure Curve of Xenon. W. Heuse and J. Otto. *Zeits. f. techn. Physik*, 13. 6. pp. 277-278, 1932. *From the Reichsanstalt.*—Describes a new determination of the vapour-pressure curve of Xe close to the normal boiling point. The results are in agreement with those of other recent observers. Temperatures are given to five figures. The triple point is also determined. G. G. S.

3823. Vapour Pressures and Latent Heats of Vaporisation of Hydrocarbons. J. B. Maxwell. *Indust. and Engin. Chem.* 24. pp. 502-505, May, 1932.—Data on paraffin hydrocarbons are correlated by plotting the reciprocals of the absolute temperatures against those of hexane at the same vapour pressures. As in the case of the Cox chart, these are all straight lines, and intersect at one point. A relation between the latent heats of hexane and those of other hydrocarbons is developed from the Clapeyron equation, the vapour-pressure equation, and the deviations of the saturated vapours and liquids from the ideal gas law. It is found that the ratios of the latent heats of any hydrocarbon to those of hexane are constant at the same reduced pressures. It is found also that other substances obey a similar rule, i.e., if the latent heat at any vapour pressure and the critical pressure of a substance are known, latent heats at other vapour pressures can be determined from a standard substance, such as hexane or water. T. B.

3824. Surface Energy and Heat of Vaporisation of Liquids. L. S. Kassel and M. Muskat. *Phys. Rev.* 40. pp. 627-632, May 15, 1932.—An approximate calculation of the total surface energy of non-polar liquids is made, by using forces obtained from quantum theory. The formula obtained is somewhat different from that previously used by Margenau [see Abstract 3293 (1931)], and it is suggested that his calculation gives either the free surface energy, or some closely related quantity. The calculations are made by assuming both that the positions of the molecules obey the simple Maxwell-Boltzmann distribution law appropriate to a dilute gas, and that the distribution is uniform outside of the excluded regions caused by the (approximate) impenetrability of the molecules. For argon, neon, nitrogen and oxygen the experimental values lie between those computed on these two extreme assumptions; for helium the calculated value is too great, even when uniform distribution is assumed, due probably to the importance of zero-point energy for liquid helium. The heat of vaporisation has been calculated in a similar way, and for it also the experimental values lie between those based on the two different distributions, except for helium, where the zero-point energy shows up still more prominently, as would be expected. AUTHORS.

3825. Law of Equilibrium Between Two Phases. G. Antonoff. *Kolloid Zeits.* 59. pp. 7-12, April, 1932.—The definite relationship is
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established of $a_{12} = a_1 - a_2$, where a_{12} is the boundary surface tension, and a_1 and a_2 the surface tensions of two mutually saturated liquid layers in the presence of the common gaseous phase. The work of Hardy, Harkins and Reynolds is also discussed. H. H. Ho.

3826. Critical Data of Two-Component Systems. C. A. Winkler and O. Maass. *Canad. J. of Research*, 8, pp. 458-470, May, 1932.—The so-called critical temperatures and critical pressures for two-component systems are defined. For the first time three two-component systems have been investigated, involving three components taken two at a time. The three components were propylene, methyl ether and carbon dioxide. An experimental technique involving several new features is described. Accuracy in the determination of both critical temperatures and pressures is claimed. The system sulphur dioxide-methyl ether was also examined, and the conclusions of previous investigators regarding compound formation confirmed. The results of the other three systems are analysed, and a theoretical discussion of these results reserved for a later publication.

AUTHORS.

3827. Rectilinear Diameter for Carbon Monoxide. E. Mathias, W. J. Bijleveld and P. P. Grigg. *Comptes Rendus*, 194, pp. 1708-1710, May 17, 1932.—The densities of liquid carbon monoxide and of its saturated vapour are measured at temperatures θ between -141° and -205° C. The rectilinear diameter for the substance is slightly concave to the temperature axis near the critical point, and slightly convex at lower temperatures. The ordinates of the diameter, considered straight, may be calculated from the equation $y = 0.03290 - 0.0019120\theta$. The greatest deviation from this line is 1%. The critical density d is found to be 0.3010 gm./l., and the critical coefficient $R\theta d/\pi = 3.395$. J. P. A.

3828. Proportionality of the van der Waals Constants a and b . I. Traube. *Kolloid Zeits.* 59, p. 136, May, 1932.—Ray's paper [see Abstract 4248 (1931)] on the constant character of the ratio a/b is referred to, and the priority in this field of Bodenstein for the cases of gases and of the writer [*Zeits. f. phys. Chem.* 68, 289 (1909)] for liquids is emphasised. A table of a/b ratios at 0° C. for 35 liquids is reprinted from the above paper. H. H. Ho.

3829. Hydrogen and its Uses. E. F. Armstrong. *Roy. Soc. Arts*, J. 80, pp. 611-624; *Disc.*, 624-627, May 6, 1932.—This very informative lecture commences with a brief account of the history of hydrogen and of its properties, including its band spectrum and its existence in two stable configurations. The liquefaction of hydrogen and the subject of hydrogen ion concentration are next considered, and are followed by a description of the commercial practicable methods of making hydrogen for airships, viz., the electrolytic, the ion contact and the silicon process. The atomic welding arc of Langmuir is then discussed, and this is succeeded by detailed accounts of some large-scale uses of hydrogen, viz.: for the hydrogenation or hardening of fats and of organic substances generally, also of mineral oil and coal, and for the conversion of nitrogen to ammonia. One of the good features of the hydrogenation process, which in the future may have some bearing on its application, is the property hydrogen has of removing noxious sulphur in the form of H_2S . The paper should be read in its entirety, since it constitutes a valuable compendium on this most important subject. H. H. Ho.

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SOUND.

3830. Sound Velocity in Reactive Mixtures of Real Gases. D. G. C. Luck. *Phys. Rev.* 40. pp. 440-444, May 1, 1932.—Einstein's derivation of the dependence of sound velocity on frequency in a mixture of chemically reacting ideal gases of negligible absorption has been extended to mixtures of real absorbing gases. The results show that deviations of experiment from the earlier theory are probably due to departure of the gases from ideal properties. They also show that absorption is probably strong enough to render reaction rate determination by velocity measurements impossible, but that direct absorption measurements may be of some use. It is shown that extraneous phenomena may hide those considered. AUTHOR.

3831. Sound Diffraction by Various Shaped Screens. L. J. Sivian and H. T. O'Neill. *Acoustical Soc. of America, J.* 3. pp. 483-510, April, 1932.—The author considers the diffraction produced by a circular and a square plate, and a semi-infinite screen, both from the experimental point of view and the theoretical. For the experiments, a point source of sound is used, sometimes in a lagged box and sometimes in the open air. Sound pressure measurements are made with a long narrow search tube connecting with a condenser transmitter. The sound pressure is measured on both sides of the diffracting screen for various azimuth angles and curves are shown. An approximate theory is given, and theoretical and experimental results are compared graphically, from which it appears that discrepancies occur at the lower frequencies. The special case of a circular plate at the end of a long cylinder is also investigated. The theory of diffraction by a semi-infinite screen is discussed in detail and adapted to easy calculation. Several examples of its use are shown. J. E. R. C.

3832. Loudness and Intensity Relations. L. B. Ham and J. S. Parkinson. *Acoustical Soc. of America, J.* 3. pp. 511-534, April, 1932.—An account of an investigation designed to test the ability of the human ear to judge the relative intensities of two sounds. A series of observers were placed in a sound field and were asked (1) to estimate the ratio of apparent loudness of two tones; (2) to adjust a tone to be $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$ as loud as another; (3) to adjust a tone to be 2, 3 and 5 times as loud as another. Frequencies of between 250 and 2500 $\sim$ were used and intensity levels of between 34 and 84 db above the threshold of audibility. The authors deduce that the results do not agree with the Weber-Fechner law, and decide that an equation of the form $y = a + be^{ax}$ fits their results better. All individuals of normal hearing were found to be capable of making consistent judgments. In no case were loudness changes found to be additive. A new scale of loudness measurement is proposed as a result of the experiments, and a unit, the "multiple loudness unit" (m.l.u.) is suggested. On this scale 10 m.l.u. is equivalent to 30 db above minimum audibility, 100 m.l.u. to 60 db and 1000 m.l.u. to 90 db. The above results are based upon the judgments of 175 individuals. J. E. R. C.

3833. Effect of Position on the Absorption of Materials for the Case of a Cubical Room. C. A. Andree. *Acoustical Soc. of America, J.* 3. pp. 535-551, April, 1932.—In order to determine the absorption VOL. XXXV.—A.—1932.

coefficient of various materials, use is made of a well-known formula involving the decay of sound in a room. The author points out the limitations of the formula and discusses the acoustic behaviour of a cubical room having walls of different materials. It is shown, by making various permissible assumptions, that the theoretical absorption coefficient or the decay factor of this room can be varied considerably, and it is suggested that the normally accepted formula should be used with caution. The author discusses the most effective means of utilising absorbent material in a room, and applies his methods of averaging to a definite case using Sabine and Eyring's formula. Appreciable variation is shown in the results, and indicates the need for further research. G. A. V. S.

3834. Absorption of Sound in Gases at High Frequencies. E. Grossmann. *Ann. d. Physik*, 13. 6. pp. 681-702, May 21, 1932.—The absorption of sound between 3×10^4 and $3 \times 10^5 \sim$ is measured by a new method. Generator and receiver are two piezoelectric quartzes with almost the same resonance frequencies. These are placed in an enclosure containing the gas. The generator is made to vibrate with constant amplitude at its resonance frequency, and the energy in the circuit of the receiving quartz is measured by a thermocouple, when the receiver is at various distances. Disturbing effects of all kinds are investigated. Contrary to the Stokes-Kirchhoff theory, the coefficient of absorption is found to vary with the frequency, particularly in CO_2 and SO_2 , and is always far in excess of values predicted by this theory. J. P. A.

3835. Interference Elimination with the Warble Tone. W. L. Barrow. *Acoustical Soc. of America*, J. 3. pp. 562-578, April, 1932.—The effect is discussed of a frequency-modulated tone (warble tone) in eliminating the disturbing space and time-interference phenomena which accompany the use of a single tone in objective acoustical measurements. A criterion for determining the minimum allowable frequency variation is set up, and thence the relative change in frequency derived in terms of the original frequency and the path difference L , where L denotes the difference in distances from source to transmitter travelled by the direct and reflected sound waves. It is then shown that the effectiveness of the warble tone depends upon L and upon the middle frequency f_0 . It is demonstrated that a very slow frequency variation through a given band may be replaced by several simultaneous equal amplitude components arranged symmetrically within that band, under certain conditions. The standing waves (R.M.S. value) produced by a warble tone are calculated and illustrated as an example and the standing waves of simultaneous equal amplitude tones are also shown. The factors governing the elimination of transient interference with the warble tone are found to be the same as those valid for the elimination of standing waves. G. A. V. S.

3836. Theory of Vibrating Membranes and Plates. R. C. Colwell and J. K. Stewart. *Acoustical Soc. of America*, J. 3. pp. 591-595, April, 1932.—The formulae previously derived [see Abstract 169 (1932)] are employed to calculate the positions of nodal lines on a vibrating rectangular plate. The gradual development of complexity with increase in the number of lines is traced out. Many of the more complicated figures may be found by combining simpler figures. J. P. A.

ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

3837. Piezoelectric Gauge for Recording Gas Pressure in Shot-Guns. C. T. Ervin. *Frank. Inst.*, J. 213. pp. 503-514, May, 1932.—A series of quartz plates are arranged in a column, and so connected that the charges due to a compression of the column add. The pressure due to an explosion in an experimental gun barrel is communicated to this column and the voltage developed is amplified by a three-stage amplifier. The output is applied to an oscillograph. Numerous meters enable the characteristics of the amplifier to be controlled. The gauge is calibrated by applying a known force by a lever arrangement. Typical results are given of experiments upon different types of powder. J. E. R. C.

3838. Determination of Moisture in Seeds and Other Granular Substances. R. M. Davies. *Phys. Soc., Proc.* 44. pp. 231-241; *Disc.*, 241-245, May 1, 1932.—Methods previously available for the determination of the moisture-content of seeds are summarised and discussed. Two new methods are described, the first involving the use of a thermionic oscillator, the second a direct-current galvanometer and a battery. The first method is best suited for use with large-grained seed, whilst the second can be used for all types of seed. AUTHOR.

3839. Forces Acting on Drops in an Electric Field. G. D. West. *Phys. Soc., Proc.* 44. pp. 336-341; *Disc.*, 341-342, May 1, 1932.—If whilst a drop of electrolyte is falling in distilled water, a horizontal electric field be established, the drop rapidly spreads out into a filament parallel to the lines of force. An explanation of this phenomenon is given on the basis of the charge at the boundary between conductors that necessarily accompanies the transport of electricity. Experiments with dielectrics and with drops that contract instead of expand are described, and the paper is illustrated with photographs. AUTHOR.

3840. Relation $\delta = \epsilon F$ in Electrostatic Fields. P. Andronescu. *Assoc. Suisse Elect., Bull.* 23. pp. 223-232, May 13, 1932.—The author distinguishes three types of electrostatic fields. In fields of the first kind there are only metallic bodies with or without "real" electric charges; in those of the second kind there are found besides insulating bodies without "real" electric charge, and in the third category in addition insulating bodies with "real" electric surface and spatial charges. It is shown that for fields of the first class the relation $\delta = \epsilon F$ always holds (where δ = vector of the displacement, ϵ = the dielectric constant, and F = vector of the field strength); whilst for fields of the second class it holds only under certain conditions. The complicated case of the third class of field is not yet explained. J. J. S.

3841. Potential Distributions in Large Cylindrical Discs with Partially Penetrating Electrodes. M. Muskat. *Physics*, 2. pp. 329-364, May, 1932.—Because of the equivalence of the pressure in a liquid-bearing sand to a velocity potential an analysis has been carried through of the potential theory of the electrical analogue of an artesian well par-
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tially penetrating a water-bearing sand. In Part I the method of analysis is illustrated by the solution of the problem of a hemispherical electrode embedded in one of the faces of the disc. In Part II is treated the more general problem of the potential distribution for a partially penetrating electrode with a uniform flux density along the electrode surface. In Part III the problem of physical interest is dealt with, in which the electrode is at uniform potential.

3842. Dielectric Constant of Water and Its Temperature Coefficient as Determined by a Resonance Method. Part II. E. P. Linton and O. Maass. *Am. Chem. Soc., J.* 54. pp. 1863-1865, May, 1932.—A new type of variable condenser is described which has a greatly increased accuracy as far as setting is concerned, and the dielectric constants of nitrobenzene, ethylene dichloride, ether and benzene have been measured at 25° C. and of water over the range of 0 to 60° C. The values for water given by the curve:

$$\epsilon_t = 79.2[1 - 0.00428(t - 25) + 0.0000212(t - 25)^2 - 0.00000041(t - 25)^3],$$

are found to be in better agreement than former data with the calculations involved in Debye's theory. H. H. Ho.

3843. Dielectric Constant and Power Factor of Some Solid Dielectrics at Radio Frequencies. W. Anderson. *Phil. Mag.* 13. pp. 986-993, May, 1932.—The dielectric constant and power factor of twelve samples of different dielectrics were measured over the frequency range 150 to 1500 kc. For most of the samples (glass, porcelain, ebonite, keramot, paxolin, bakelite) there was no appreciable change in the two constants, with frequency, and the data are tabulated. For millboard, india-rubber and an inferior ebonite, curves showing the variation with frequency are given, but it was found impossible to fit a formula of the type given by the Debye theory of polar molecules. W. S. S.

3844. Dielectric Behaviour of Colloidal Particles with an Electric Double Layer. J. B. Miles, Jr., and H. P. Robertson. *Phys. Rev.* 40. pp. 593-591, May 15, 1932.—The dielectric behaviour of colloidal particles is treated mathematically. The particles are assumed to be spheres and the electric double layer is represented by a concentric conducting shell. Assuming that the conductivity of the shell is large compared with that of the particle and that its thickness is small compared with the radius of the particle, the relaxation time in sec. is given by $3\epsilon a / 8\pi c \lambda_2 d$, where ϵ is the dielectric constant of the material of the particle, a its radius in cm., c the ratio of the e.m.u. to the e.s.u., λ_2 the conductivity of the shell in e.m.u., and d its thickness in cm. A distribution of particle size is assumed, and by the use of Wagner's treatment of non-homogeneous media expressions are obtained for the capacity and power factor as functions of the frequency. It is thus shown that the dielectric behaviour predicted by Wagner for an assemblage of spheres having different specific conductivities may also result from an assemblage of colloidal particles of non-uniform size.

AUTHORS.

3845. Dielectric Properties of Glycols. A. H. White and S. O. Morgan. *Physics.* 2. pp. 313-321, May, 1932.—The Debye theory of polar molecules leads to the conclusion that the anomalous dispersion due to dipoles which has been observed at high frequencies should also

be found at low frequencies. Supercooled glycols are viscous enough at low temperatures to show dispersion at low frequencies. Real and imaginary dielectric constant and power factor are calculated and their interrelationships are discussed. Better than qualitative agreement with the Debye theory is observed in the pure pentandiol, but not in the solution measurement. **Erratum, *ibid.*, 3, p. 53, July, 1932.** AUTHORS.

3846. Dielectric Polarisation of Acetylcellulose in Solution. W. Haller and H. Orloff. *Kolloid Zeits.* 59, pp. 137-143, May, 1932.—The method of comparison of capacities in h.f. circuits here described is suited especially to the determination of differences of capacities or dielectric constants. The polarisation of acetylcellulose in various solvents and solvent mixtures usually decreases as the concentration increases, and varies as the solvent has good or poor solvent properties; in the latter the polarisation approaches an upper limiting value of 0.66. In mixtures of solvents of high and low activities, the polarisation is numerically equal to that in the pure highly active solvent, which is hence preferably adsorbed. The extrapolated dielectric constant for pure acetylcellulose is 17.25, which is appreciably higher than the value for the substance in the mass. The following dielectric constants have been determined: methylglycol acetate, 8.81; methylglycol, 17.18; diacetone alcohol, 18.19; and ethyl acetylglucolate, 7.96. A method is given for calculating the adsorption solvation of the acetylcellulose micelle from the polarisation data. It is found that 1 gm. of acetylcellulose binds dielectrically between 0 and 0.4388 gm. of liquid, according to the solvent. The high viscosity of acetylcellulose solutions is attributed only in small degree to solvation, and mostly to the formation of aggregates. T. H. P.

3847. Development of Polar Characteristics in Insulating Oils. W. N. Stoops. *Physics*, 2, pp. 322-328, May, 1932.—It is shown that the decomposition in transformer oils may be followed rather closely by measuring the dielectric constant of the oils as they deteriorate in service, the method being sufficiently accurate to distinguish between different oils. These data are compared with those obtained on oils decomposed very much more rapidly in laboratory tests. The change in polar characteristics is definitely correlated with change in chemical characteristics. That the change in dielectric constant of the oils is due to the formation of polar molecules is shown by a study of the variation of the dielectric constant and power factor of the decomposed oils with temperature and frequency. [See also Abstract 3547 (1931).] AUTHOR.

3848. Anomalous Electrical Dispersion of Polar Solutions. R. Goldammer. *Phys. Zeits.* 33, pp. 361-367, May 1, 1932.—This investigation deals with the anomalous dispersion of *n*-butyl-, iso-butyl- and iso-amyl-alcohols in dilute solutions in various solvents in the light of the Debye theory. Resonance methods were employed using $\lambda = 25$ m. and $\lambda = 250$ m., and also Drude's method for wave-lengths of 0.5 to 1.4 m. It was found that the short-wave investigation gave information as to the course of the molecular friction and association phenomena. The experimental results when compared with the calculated values show good qualitative agreement. H. H. Ho.

3849. Association in Dipole Liquids. J. Malsch. *Phys. Zeits.* 33, pp. 383-390, May 1, 1932.—The temperature, field strength and frequency dependence of the dielectric constants of various strongly associated
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dipole liquids (butyl-, ethyl-, propyl-alcohols, water), are discussed from the data of previous observers, and the stronger influence of association on the two former quantities explained. H. H. Ho.

3850. Dipole Measurements in the Di- and Triphenyl-Methane Series. E. Bergmann, L. Engel and H. A. Wolff. *Zeits. f. phys. Chem.* 17. *Abt.B.* 2-3. pp. 81-91, May, 1931.—The known dipole moments of the di- and trihalogeno-methanes are considered from the standpoint of how far the deviations from the theoretical values are produced by angle distortion, e.g., by decreasing the halogen moments. The dipole moments of several compounds of the di- and tri-phenyl-methane series have been determined. From the data obtained the valency angles are calculated and the results discussed. H. H. Ho.

3851. Dipole Measurements of Fluorene Derivatives. E. Bergmann, L. Engel and H. Hoffmann. *Zeits. f. phys. Chem.* 17. *Abt.B.* 2-3. pp. 92-99, May, 1932.—The stereo-chemical and valency-chemical characteristics of the fluorene system are discussed from measurements now recorded of the dipole moments of 9-chloro-, 9:9'-dichloro-, 2:7-dibromo- and 2:9-diamino-fluorene, fluorene itself, fluorenone and 2-nitro fluorenone. H. H. Ho.

3852. Dipole Moment of n-Propyl Ether. L. Meyer and A. Büchner. *Phys. Zeits.* 33. pp. 390-391, May, 1932.—Sänger and Steiger's value for the dipole moment μ of n-propyl ether, 0.85×10^{-18} e.s.u. [see Abstract 2891 (1930)], and their conclusions that the oxygen angle changes along the ether series are discussed. A new value $1.16 \pm 0.05 \times 10^{-18}$ e.s.u. is determined from the temperature dependence of the molecular polarisation of a dilute hexane solution of the ether which indicates that the behaviour of the dipole moment in the ether series is identical with that in other homologous series, and that the oxygen angle remains unchanged. H. H. Ho.

3853. Dipole Moments of Molecules with Several Axes of Free Rotation. C. T. Zahn. *Phys. Zeits.* 33. pp. 400-405, May 15, 1932.—In this paper a simple expression has been derived, without explicit integration, for the mean square of the dipole moment of a molecule with a three-dimensional system of several axes of free rotation, by means of a vector method and the usual ideal assumptions, and is applied to several special cases. In the most general case of a variable axial system, the mean square moment is shown to be derived by successive applications of the above formula, and their case is illustrated by the system of the triaxial ethylene-glycol molecule. H. H. Ho.

3854. Dipole Moments of Aromatic Nitriles and Isonitriles. H. Poltz, O. Stell and O. Strasser. *Zeits. f. phys. Chem.* 17. *Abt.B.* 2-3. pp. 155-160, May, 1932.—This paper contains measurements of the dipole moments of toluene, benzonitrile, benzo-isonitrile, o-, m-, p-tolunitriles, o-, p-tolu-isonitriles, o-chlorobenzonitrile, p-chlorobenzo-isonitrile, and o-, m-, p-nitrobenzonitriles, which are discussed in relation to molecular structure. H. H. Ho.

3855. Dipole Moments and Molecular Structure. Parts I and II. J. W. Smith. *Roy. Soc., Proc.* 136. pp. 251-263, May 2, 1932.—In Part I details of apparatus and operation are given of a simple resonance

method for measuring the dielectric constant of solutions. In Part II the dielectric constants, measured at 25° and at 40° C. by the above method, and the densities are recorded for a series of dilute solutions of PCl_3 , AsCl_3 and SbCl_3 in benzene. The calculated electric moments of these molecules increase with increasing atomic weight of the Group V element, this being the reverse of the order observed in the case of the hydrides.

H. H. Ho.

3856. Electric Moment and Molecular Structure. Part VII. The Carbon Valence Angle. C. P. Smyth and W. S. Walls. *Am. Chem. Soc., J.* 54. pp. 1854-1862, May, 1932.—The electric moments of several benzyl and para-substituted benzyl compounds have been determined and used together with values in the literature to calculate the angle between the valencies of the carbon atom. The value obtained, 114°, differs from the theoretical tetrahedral angle by no more than the probable error. [For Part VI see Abstract 2064 (1932).]

H. H. Ho.

3857. Electric Field of Overhead Thunderclouds. S. K. Banerji. *Roy. Soc., Phil. Trans.* 231. pp. 1-27, March 16, 1932.—Continuous records were obtained showing potential gradient, charge of rain drops, rainfalls wind velocity and direction, pressure and temperature throughout seven line-squalls and six heat storms at Bombay; eight of these are reproduced, with three electrograms illustrating sudden changes in the electric field due to lightning. The results are discussed in detail, and shown to confirm previous conclusions. Wilson's law is satisfied. An average thundercloud transfers to the ground by rainfall 6000 coulombs of positive and 7000 of negative electricity. [See Abstract 4076 (1930).]

C. A. S.

3858. Influence of Earth Resistance upon Lightning Discharge. F. Ollendorff. *Phys. Zeits.* 33. pp. 368-376, May 1, 1932.—A mathematical investigation into the problem of lightning discharge from cloud to earth in which the earth is considered as a homogeneous plane conducting surface of conductivity k and thickness δ . A finite numerical value of the earth resistance can be associated with this conception by assuming it to be the reciprocal of the limiting value of $k\delta$ when δ approaches zero. The paper cannot be satisfactorily abstracted and the original should be consulted.

L. F. M.

3859. Secondary Effects of Penetrating Corpuscular Radiation. B. Rossi. *Phys. Zeits.* 33. pp. 304-305, April 1, 1932.—The existence of a relatively weaker penetrating corpuscular radiation produced by corpuscular rays in matter was tested by means of an arrangement of three Geiger-Müller counting tubes. When the whole arrangement was screened by a lead covering, 35.5 ± 1.3 coincidences per hour were counted, whilst when the upper portion of the screen was removed the number of coincidences per hour fell to 10 ± 0.5 . Thus the existence of a secondary radiation along the course of the penetrating corpuscular rays through the lead may be considered as proved. [See following Abstract.]

J. J. S.

3860. Secondary Effects of Penetrating Corpuscular Radiation. B. Rossi. *Accad. Lincei, Atti*, 15. pp. 734-741, May 1, 1932.—A continuation of the author's account of his researches on this subject [see preceding Abstract]. In the present paper the numerical results obtained by the method described in the former paper are given in detail. There are

indications that the secondary radiation produced in iron has a greater energy than that generated in lead, and further experiments are being carried out. J. J. S.

3861. Anomalies of Absorption of Penetrating Radiation. B. Rossi and B. Crino. *Accad. Lincei, Atti*, 15. pp. 741-746, May 1, 1932.—The object of the experiments described was to study, by means of measurements of the absorption in small thicknesses of lead, the influence of the secondary radiation on the experiments made by the method of coincidences, and to examine how this influence depends on the position of the absorbing screen with respect to the tube counters of Geiger and Müller which were used in the investigations. Two different measurements of absorption were made. In the first the penetrating radiation arrived at the counters after traversing the equivalent of about 12 cm. of water; in the second set a screen of lead 8 cm. thick was interposed. In both cases a rapid decrease of coincidences with increasing thickness of lead was shown, due to absorption of the secondary corpuscular radiation. In the second set with radiation first filtered through lead this effect was more marked; here the secondary rays are fewer and besides, being generated at a small distance from the counters, they arrive in part upon these accompanied by the corresponding primary rays so that all do not get singularly registered. It was found that with the screen placed above the counters the systematic coincidences were about 10 % more frequent than with the screen between them; this appears to be due to the secondary radiation generated in the screen. Various effects found are considered to be due to this secondary radiation and not to new corpuscular rays produced by the hypothetical ultra- γ radiation. J. J. S.

3862. Cosmic-Ray Energies and Their Bearing on the Photon and Neutron Hypotheses. R. A. Millikan and C. D. Anderson. *Phys. Rev.* 40. pp. 325-328, May 1, 1932.—Gives an account of measurements made by C. D. Anderson on the energies of cosmic ray tracks, and of a number of other observations. The cosmic rays are absorbed primarily by the nucleus rather than by extra-nuclear electrons. The curvature of the tracks produced by a 17,000-gauss magnetic field corresponds more frequently to positive than to negative particles. Positive particles can obviously come only from the nucleus. In some 17 % of the encounters the nucleus was disintegrated, both positive and negative particles being thrown out of it. Only the photon hypothesis appears to fit the facts, and the authors do not consider that neutrons are concerned in cosmic ray phenomena. H. N. A.

3863. Theoretical Consideration of High-Altitude Radiation. W. Heisenberg. *Ann. d. Physik*, 13. 4. pp. 430-452, May 4, 1932.—The behaviour of very rapid electrons in their passage through matter is first discussed, with particular regard to (a) retardation, (b) scattering, and (c) the distribution law of secondary electrons. The absorption and scattering of hard γ -rays are then dealt with under the headings (a) the Klein-Nishina formula, (b) scattering by atomic nuclei and (c) the distribution law of secondary electrons. Various researches on high-altitude radiation are then discussed. From the results obtained it follows, if no new physical hypothesis is introduced to explain the effects, either that the Klein-Nishina formula for the absorption of highly energised light quanta gives a value about 25 times too small, or that the formula obtained

on the basis of the classical and quantum theories for the retardation of rapid electrons gives too small a value. The transfer effect and the measurements of Skobelzyn [see Abstract 3088 (1929)] can, however, be explained—at any rate qualitatively—by the theories at present given. Possible explanations of the causes of the discrepancies are suggested. [See also Abstract 2413 (1928).] A. W.

3864. Theory of the Vertical Counting-Tube Effect of Cosmic Radiation. W. Kolhörster. *Preuss. Akad. Wiss. Berlin, Ber.* 5. pp. 39-43, 1932.—If a sufficiently long counting tube is turned round a horizontal axis which is at right angles to that of the counting tube the impact number proves to be dependent on the angle between the counting tube axis and the vertical. This vertical counting-tube effect was first observed by Tuwim, and used by him for the working out of a theory, on a geometrical basis, of the behaviour of counting tubes confronting cosmic rays. In the present paper a new proof of the theory of wider scope is given, based on the approximation formula deduced from the series development according to counting-tube functions, formerly given by Tuwim, and obtained from special observations of the impact number. J. J. S.

CURRENT ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM.

3865. Influence of Electrodes on Conductivity of Semi-Conducting Liquids. J. Sambussy. *Comptes Rendus*, 194. pp. 1724-1725, May 17, 1932.—A p.d. (up to 3000 volts) was maintained between electrodes of Pt, Pd, Pb and Ta separated by 5 cm. of nitrobenzene dried over CaCl_2 and distilled. With Pt or Pd the distribution of p.d. is linear, and back e.m.f. 1.4 volts; with Pb there is a big drop in potential at the anode, back e.m.f. 2.5 volts; with Ta the drop is 250 volts, back e.m.f. 140 volts. These results are due to traces of water in the nitrobenzene. [See Abstract 1332 (1932).] C. A. S.

3866. Anomalous Variation of Electrical Conductivity of Quartz with Temperature. S. Shimizu. *Phil. Mag.* 13. pp. 907-934, May, 1932.—A study is made of the electrical conductivity of quartz with temperature, especially to find out if any discontinuous variation of conductivity occurs at the transformation temperature. Two quartz plates are tested, one cut perpendicular and the other parallel to the optic axis. The conductivity increases slowly up to 573°C ., where a point of discontinuity is observed before the resumption of the steady increase for higher temperatures. Oxidation of the electrode metal smooths out the discontinuity at the transformation point. H. M. B.

3867. Theory of Change of Electrical Resistance with Pressure. K. Honda, T. Nishina and T. Hirone. *Zeits. f. Physik*, 76. 1-2. pp. 80-90, May 12, 1932.—A theory giving quantitative agreement for the change of electrical resistance with hydrostatic pressure for 27 different metals is obtained by making allowance for the collisions of free electrons in the Højendahl-Frenkel theory of free electrons. The occurrence of a minimum in the case of caesium and of a steady rise or fall of resistance in other metals is fully accounted for. The theory predicts that in the case of metals whose resistance decreases with increasing pressure, there is a minimum as yet undiscovered at some very high pressure. A. C. M.

3868. Resistivity of Binary Aggregates. G. S. Frey. *Arkiv f. Kem. Min. och Geologi, Stockholm*, 10. 4. pp. 1-33, 1932. *Zeits. f. Elektrochem.* 38. pp. 260-274, May, 1932.—Determines the way in which the resistivity of binary aggregates like Ag-Bi or Pb-PbS depends upon the process of crystallisation. This process depends upon whether the more highly-conducting component or the less highly-conducting component forms a coherent network. In the latter case, as in the Ag-Bi, Mg-Pb and Mg-Sn alloys, the Rayleigh-Maxwell law is particularly applicable.

E. E. F. d'A.

3869. Researches on the Zinc-Aluminium Alloy, Al_2Zn_3 . H. Meyer. *Zeits. f. Physik*, 76. 3-4. pp. 268-280, May 31, 1932.—The phenomenon of improvement has been known for 20 years. A. Wilm showed that the alloy duralumin after quick cooling from over $420^\circ C$. by keeping at room-temperature becomes harder. The metal in this more solid condition retains its former ductility. The effects on electrical resistance are considered in this paper. The three different types of change of conductivity are dealt with and the influence of the improvement temperature. The temperature coefficient is considered as measure of the transformation. The action of alternating temperatures is considered: constantly repeated rise in the colder and immediate reconstitution of the resistance in the warmer of two baths. The selectively controllable course of the phenomenon is observed. The fact of greatest importance is the relative position of the temperatures. The theory and explanation of the phenomenon are discussed.

J. J. S.

3870. Measurements with the Aid of Liquid Helium. Part XIV: Alloys. Part XV: Barium, Indium, Thallium, Graphite and Titanium. W. Meissner, H. Franz and H. Westerhoff. *Ann. d. Physik*, 13. 5. pp. 505-563, May 13, 1932.—In Part XIV the resistance-temperature curves for several systematic series of alloys are investigated. In all cases the alloys consisted of two components, each of which, when pure, shows the phenomenon of supraconductivity. The series were: (1) the completely miscible system In-Pb; (2) the systems Sn-Te and Pb-Hg, in which one component has a definite solubility in the other; (3) the system In-Te, in which there is miscibility from either end point, with a eutectic region between; (4) the system Mo-C, which always consists of two phases. The curves of transition point against composition take different forms in the different types of system, and detailed consideration is given to the theoretical interpretation of this curve in the case where the alloy consists of mixed crystals. Part XV deals with the resistance-temperature curve of the purest obtainable specimens of Ba, In, Ti, C and Ti, over the whole range from very low temperatures up to $273^\circ K$. [See also following Abstract.]

J. H. A.

3871. Measurements with the Aid of Liquid Helium. Part XVI. Supraconductivity of Carbides, Nitrides, Borides and Silicides. W. Meissner, H. Franz and H. Westerhoff. *Zeits. f. Physik*, 75. 7-8. pp. 521-530, April 20, 1932. *From the Reichsanstalt*.—A large series of these compounds has been studied down to $1.2^\circ K$., and it is found that not only the carbides and nitrides but also the silicides and borides of heavy metals become supraconducting. The change point is lower for the last two than for the first two types of compound.

J. H. A.

3872. Measurements with the Aid of Liquid Helium. Part XVII. Resistance of Lead in Magnetic Field, below the Transition Temperature. W. Meissner. *Ann. d. Physik*, 13. 6. pp. 641-648, May 21, 1932.—The resistance of a metal which is in the supraconducting state can be raised by application of a magnetic field; in other words, supraconductivity sets in at a lower temperature, in the presence of a magnetic field, than in its absence. By delineating the resistance-field curve experimentally at 1.3 and at 4.2° K. the resistance which the metal would have at these temperatures in the absence of a field is deduced by extrapolation. These values are found to lie on a smooth curve with resistance values observed at temperatures above the transition point, and this curve is therefore taken to represent the resistance-temperature relation which would hold for lead if supraconductivity did not occur. The bearing of the results on Kapitza's theory is considered. J. H. A.

3873. Measurements with the Aid of Liquid Helium. Part XVIII. Behaviour of Supraconducting Tin on Bombardment by Slow Electrons. W. Meissner and K. Steiner. *Zeits. f. Physik*, 76. 3-4. pp. 201-212, May 31, 1932.—The origin of supraconductivity must remain obscure until it is ascertained whether the current is carried by electrons which are truly free, or whether the electrons concerned are more or less loosely coupled to atoms. McLennan, McLeod and Wilhelm have shown that swift electrons do not pass freely through a supraconducting foil, and the present paper examines slower electrons. These do not pass through, whether the foil is in the supraconducting state or not. It appears, however, that the velocity of the electron, after entering the metal, is of the same order as that of the conduction electrons, on the modern theory. J. H. A.

3874. Supraconductivity. K. Clusius. *Zeits. f. Elektrochem.* 38. pp. 312-326, May, 1932.—An attempt to collect together the salient facts discovered in connection with supraconductivity. The phenomena of the transition point itself and of the destruction of supraconductivity by magnetic fields and by the use of a.c. are dealt with. The effect of mechanical strain is also mentioned, and there is a considerable section dealing with supraconductivity in alloys and compounds. Several theories of the effect are also touched on, and there is a Bibliography of 91 entries. J. H. A.

3875. Theory of Electrical Resistance and Supraconductivity in Metals. E. Kretschmann. *Ann. d. Physik*, 13. 5. pp. 564-598, May 13, 1932.—A theoretical treatment on modern lines, of the problem of electrical resistance as a function of temperature, magnetic field and pressure. There is also a very short section dealing with thermal conductivity. J. H. A.

3876. Supraconductivity with H.F. Alternating Currents. J. C. McLennan, A. C. Burton, A. Pitt and J. O. Wilhelm. *Roy. Soc., Proc.* 136. pp. 52-76, May 2, 1932.—The resistance of a coil of lead wire towards currents of frequency $1 \cdot 1 \times 10^7 \sim$ falls to less than one-hundredth of its original value at a temperature slightly below the critical temperature (7.2° Abs.) observed when d.c. is used. With a coil of tin wire the resistance to d.c. commences to fall sharply at 3.76° Abs. and disappears completely at 3.70° Abs.; with h.f. current the corresponding temperatures are 3.67° and 3.61° Abs. Experiments with higher frequencies ($1 \cdot 6 \times 10^7$)

show that the depression of the critical transition temperature increases with increasing frequency, and by extrapolation a frequency of 10^9 is found to correspond with a critical temperature of 0° Abs. Similar results are obtained with tantalum, and these experiments show that the transition to the supraconducting state is less abrupt with h.f. current than with d.c. The depressions observed are not attributable to the magnetic or heating effects of the current, and are not a direct function of the skin effect. H. F. G.

3877. Corbino Effect. C. A. Beck. *Phys. Rev.* 40. pp. 607-620, May 15, 1932.—This effect, which is essentially the Hall effect on induced currents in circular discs, was found in bismuth by Corbino. According to his theory, the quantity of charge transported through the circuit of resistance R is $-(1/8\pi R)c_H S H^2$, where the coefficient, c_H , corresponds to the final field H , and S is the area of the disc. On the other hand, K. K. Smith derived the following formula for the equivalent change of flux, $N = -(S/4\pi) \int_{H_1}^{H_2} c_H dH$. These expressions agree only if c is independent of H . Our experiments on bismuth show that the value of the coefficient derived from the first formula is always greater than that derived from the second. This discrepancy is explained by the fact that the coefficient c decreases as the strength of the field increases. The ratio of Hall coefficient to resistivity, found for plates cut from the discs, agrees quite well with the coefficient c_2 derived from the second formula. In antimony the induced effect, small and opposite in sign to that in bismuth, is found. In this metal the coefficients decrease only slightly with the field, and no discrepancy between c_H , c_2 and R/ρ has been detected. In the case of bismuth, the graphs relating the induced throws and magnetic field are, for sufficiently strong fields, linear. Hence one can deduce simple expressions for the Hall and Corbino coefficients in intense fields. AUTHOR.

3878. Arc, Spark and Glow: A Note on Nomenclature. J. Thomson. *Phil. Mag.* 13. pp. 824-834, April, 1932.—Engineers, physicists and spectroscopists all use the terms arc and spark to define certain discharge phenomena, but the connotation of each term differs for these three classes of investigator. For the engineer the "spark" is a bright high-potential discharge such as the first discharge of a condenserless induction coil, the subsequent surges being "arcs." In the physicists' investigation of discharge phenomena the spark refers to the initial stage of a discharge where the current is carried entirely by gaseous ions between cold electrodes, whereas in the arc the current is carried by the vaporised electrode material as well as the gas. The spectroscopist differentiates "arc" and "spark" spectra according to whether the spectral lines originate from the neutral atom or the ionised atom. A simple circuit is described which exhibits all types of discharge at atmospheric pressure, including the so-called glow discharge. A scheme of rational definition of the terms "spark," "arc" and "glow" is suggested. W. S. S.

3879. Dark Current Time in Condensed Discharges in Air at Atmospheric Pressure. L. B. Snoddy. *Phys. Rev.* 40. pp. 409-415, May 1, 1932.—The time of current flow prior to the appearance of luminosity in a condensed discharge was measured by means of the high-speed rotating mirror developed by Henriot and Hunguenard. The discharge was initiated by ultra-violet light from another spark gap. This light was focussed on the cathode of the gap under investigation.

The light from the two gaps after reflection by the mirror was focussed on a photographic plate. The separation of the images on the plate was a measure of the dark current time. This time was found to be a function of the electrode geometry. For symmetrical hemispherical electrodes, 6.5 mm. in diameter, 4 mm. apart, it was not greater than 2×10^{-7} sec. It increased to 3×10^{-5} sec. for a gap with two spherical electrodes, the anode 25.4 mm. and the kathode 1 mm. in diameter. As nearly as this method could determine, in all cases the luminosity appeared at the same time throughout the gap. AUTHOR.

3880. Effect of Existing Space Charges on Ignition Potential. G. Valle. *Arch. f. Elektrot.* 26. pp. 310-312, May 18, 1932.—The phenomena occurring in the discharge space between two electrodes when a series of unidirectional discharges with uniform time separation takes place are described and explained from the dynamic characteristics obtained with an oscillograph and from Rogowski's diagram. A longitudinal space-charge effect is found to appear suddenly when the time separation between the successive discharges is less than 0.001 sec. At the same time the ignition potential shows a sudden and large jump. A. W.

3881. Velocity of Lateral Spreading of Glow Discharges. M. Steenbeck. *Arch. f. Elektrot.* 26. pp. 306-309, May 18, 1932.—Observations were made by means of a rotating mirror of the velocity of lateral spreading of an anomalous glow discharge between two electrodes in the rare gases at various pressures. This velocity was found to be closely dependent on the electrode potential but independent of the gas pressure. For normal kathode fall of potential the velocity is of the order of a few metres per sec., but in the case of the anomalous kathode fall the velocity rises to over 5 km./sec. The slow spreading of the normal discharge shows that the glow-lamp type of oscillograph may give considerable errors when used even for very low frequencies. A. W.

3882. Excitation of the Glow Discharge. G. Valle. *Ann. d. Physik*, 13. 6. pp. 732-752, May 21, 1932.—An investigation of the strong extra currents in condenser discharges, in air at low pressure during the excitation, shows that there are two kinds of excitation; the direct, which takes place without measurable extra currents, and the indirect, which starts with a strong extra current dying away asymptotically to the normal current value. The theory of the subject is dealt with in detail, and is illustrated by a number of curves. H. N. A.

3883. Theory of Glow Discharge and of Low-Voltage Arc. H. A. Schwab. *Zeits. f. Physik*, 75. 11-12. pp. 823-828, May 6, 1932.—A theoretical explanation is put forward to account for the potential falls observed in gas discharges. This is applied to give an explanation of the phenomena of the abnormal low-voltage arc, recombination light, the h.f. glow discharge and the electrodeless ring discharge. [See following Abstract.] A. W.

3884. Theory of Arc Discharge. H. A. Schwab. *Zeits. f. Physik*, 75. 11-12. pp. 829-834, May 6, 1932.—The theory developed to explain the phenomena of glow discharges and low-voltage arcs [see preceding Abstract], taking into account the effect on the discharge of recombination processes, is here applied to the arc between carbon electrodes and gives an explanation of certain features hitherto unexplained theoretically. A. W.

3885. Origin of Beam of High-Speed Molecules Produced at the Kathode of an Arc Discharge. R. Risch and F. Lüdi. *Zeits. f. Physik*, 75. 11-12. pp. 812-822, May 6, 1932.—The fast-moving molecules found by many investigators to be produced in the neighbourhood of the kathode of an arc discharge are shown to be attributable to multiple ionisation of the molecules and subsequent impact of the second kind against the kathode. J. S. G. T.

3886. Measurement of Current in Electrodeless Discharges by means of Frequency Variations. J. Tykocinski-Tykociner. *Phil. Mag.* 13. pp. 953-964, May, 1932.—Inserting the electrodeless discharge tube inside a solenoid forming part of an oscillatory circuit, electromagnetic inductive coupling between the currents in the solenoid and in the discharge tube should cause an increase in the frequency of the oscillatory circuit. Measurements were made and the frequency change was found to be a decrease. This is due to axial current components arising from the purely electrostatic excitation of the solenoid. By placing the tube between two rings connected to the terminals of the solenoid, the tube was subjected to the electrostatic excitation only, and a much larger frequency decrease was observed. The difference between this decrease and that first obtained gave the increase in frequency ascribable to electromagnetic induction. The experiments were made with tubes containing hydrogen at a pressure of about 0.1 mm. Hg and the initial frequency of the oscillatory circuit equalled 3173 kc. The evidence here given for the existence of both axial and circular current components shows that J. J. Thomson's theory based on induction applies only when the induced currents are large enough to produce a conductivity in the gas sufficient to shield the electrostatic field of the excitation coil. [See following Abstract.] W. S. S.

3887. Theory of Electromagnetic and Electrostatic Induction in Electrodeless Discharges. J. Kunz. *Phil. Mag.* 13. pp. 964-975, May, 1932.—The author gives a mathematical study of the change in frequency of the exciting circuit of the electrodeless discharge, due (a) to the ring current arising from electromagnetic induction, (b) to the axial current arising from electrostatic induction. The frequency change is an increase in the former, a decrease in the latter case, as found experimentally by Tykociner [see preceding Abstract]. An experiment analogous to one by J. J. Thomson is described, showing the effect of electric forces on the glow discharge in a double sphere. W. S. S.

3888. Anomalies in Kathode Sublimation. C. Münster. *Zeits. f. Physik*, 75. 11-12. pp. 716-722, May 6, 1932.—Describes phenomena produced by an edge placed close to a glass plate, which is being silvered by sublimation from the kathode. The density of the silver deposit in the shadow of a thin quartz or metal thread shows, in general, three maxima which, under corresponding conditions, do not appear when the silver is driven over by heating. No complete explanation of the reasons for the phenomenon has been found. H. N. A.

3889. Laws of the Kathode Fall. A. v. Hippel. *Zeits. f. Physik*, 76. 1-2. pp. 1-13, May 12, 1932.—Complete equations are developed for the theory of the kathode fall of potential. Their solutions for the case of the normal kathode fall provide practically all the hitherto empirically discovered relationships. The investigation consists mainly of an extension of a paper by Compton and Morse [see Abstract 161 (1928)]. J. E. K.

3890. Electric Discharges in Liquids. Part I. Arc Discharge in Water. H. D. Carter and A. N. Campbell. *Faraday Soc., Trans.* 28. pp. 479-494, May, 1932.—A special type of low-voltage contact arc, operating under water, is described. The chemical nature of the gaseous, liquid and solid products is examined in detail. With regard to gaseous products, the results of previous workers are qualitatively, but not quantitatively, confirmed, and considerable attention is given to an inactive gaseous residue. The solid products are shown to be hydroxidic in character: the solid product from carbon arcs is shown to be a body of the nature of graphitic acid; in the latter case, traces of a sparingly-soluble high-melting acid are simultaneously produced. The apparent or mean temperatures of the under-water arcs are investigated by means of an optical pyrometer, and their variation with the temperature of the surrounding water. The variation of total gaseous yield with temperature and pressure is investigated. The mechanism of the process is discussed, and the following probabilities are arrived at: (1) the process is not a mere thermal reaction; (2) a certain proportion of the reaction is no doubt due to the fairly considerable dissociation of water vapour at the high temperatures in question, but (3) it is shown that very probably an electrical dissociation of water into H and OH ions is responsible for at least the solid products; (4) short-wave radiation effects are not excluded. A. D.

3891. Spontaneous Ionisation of Pure Liquids. A. Nikuradse. *Arch. f. Elektrot.* 28. pp. 362-378, May 18, 1932.—The nature of the spontaneous ionisation in pure dielectric liquids, such as transformer oil, hexane, chlorobenzol and toluol, is investigated. It is found that the places of origin of the charge carriers are the electrode surfaces. The saturation current varies very little with the electrode distance and is directly proportional to the surface area of the electrodes. With electrodes of unequal size a polarity effect is observed. Possible explanations of the ionisation at the surface of the electrodes are suggested. A. W.

3892. Mobility of Positive Alkali Ions in Argon, Neon and Helium. A. M. Tyndall and C. F. Powell. *Roy. Soc., Proc.* 136. pp. 145-152, May 2, 1932.—The mobilities of positive ions of Na, K, Rb and Cs have been measured in A, Ne and He, using an apparatus similar to that employed by the authors in a previous investigation [see Abstract 1713 (1932)], but having certain improvements. In each gas the mobility decreases with increase in mass of the ion. In A the mobilities range from 3.21 cm./sec./volt/cm. for Na atoms to 2.23 for Cs. The corresponding figures are 8.87 and 6.49 for Ne, and 23.1 and 19.2 for He. H. N. A.

3893. Mobility Experiments in Gaseous Mixtures and Ageing Experiments in Pure Gases. N. E. Bradbury. *Phys. Rev.* 40. pp. 524-528, May 15, 1932.—Gases to which a trace of NH_3 has been added have been known to show an abnormally high value for the mobility of the positive ion. In the experiments reported here, the method of Tyndall and Grindley for measuring ionic mobilities under conditions of high gas purity and resolving power has been employed to determine the ion spectra in the case of $\text{H}_2\text{-NH}_3$ and $\text{N}_2\text{-NH}_3$ mixtures. In the former case when the partial pressure of NH_3 was reduced to 0.15 mm., a positive ion of mobility 9.4, which is substantially equal to that of the negative ion in impure H_2 , was observed. In the case of the $\text{N}_2\text{-NH}_3$ mixtures, a positive ion of mobility 1.83 was observed in addition to the normal positive ion in the pure gas of mobility equal to 2.09. No negative ions were observed. VOL. XXXV.—A.—1932.

able. The ageing experiments reported previously [see Abstract 3199 (1931)] have been continued under conditions of high gas purity using the Tyndall and Grindley method. No ageing was observed in pure N_2 at ion ages as great as 0.5 sec. Air, however, where chemical reaction products could be formed by the X-ray ionisation source, showed similar ageing effects to those reported previously. AUTHOR.

3894. Variation of Primary Electron Current with Accelerating Voltage in Mercury Vapour. Y. Takamura. *Phys. Math. Soc., Japan, Proc.* 14. pp. 230-232, May, 1932. In English.—To find the critical potentials of mercury from the curve of the relation between the primary electron current and the accelerating voltage, measurements were made in a range of about 8 to 20 volts. Although the search for the critical potentials yielded negative results, two very clear humps were observed at 13.12 and 18.13 volts respectively. AUTHOR.

3895. Ionisation Potential of Molecular Hydrogen. W. Bleakney. *Phys. Rev.* 40. pp. 496-501, May 15, 1932.—A description is given of a mass spectrograph designed to work with gases at very low pressures. The metal parts are made entirely of tantalum and tungsten enclosed in an all-glass system which may be baked out quite thoroughly, making it possible to work with gases at pressures of the order of 10^{-6} mm. The apparatus has been applied to the study of the ionisation potential of molecular hydrogen yielding a value of 15.37 ± 0.03 volts. A discussion of all the previous measurements of this quantity is given. AUTHOR.

3896. Properties of Gases Ionised at High Frequency. A. Rostagni. *Comptes Rendus*, 194. pp. 1906-1908, May 30, 1932.—It has been noted by C. and H. Gutton [see Abstracts 2258 and 3227 (1930)] that an ionised gas in a h.f. field experiences a force which constrains the electrons to a definite statistical equilibrium. The present paper suggests a mathematical explanation of this phenomenon considered as a result of the forces due to the charged wall of the discharge tube and the positive ions. G. E. B.

3897. Ionisation and Excitation through Ionic Collision. W. Weizel and O. Beeck. *Zeits. f. Physik*, 76. 3-4. pp. 250-257, May 31, 1932.—Measurements of ionisation-yield with inert gases by collision of positive alkali ions with high and rather sharp onset potentials have given a sudden increase of yield. This phenomenon is explained in the sense of an Auger effect. The discussion of the mechanism of the collision of two atoms (or ions) shows how there can occur, as in this way, excitations, ionisations and simultaneous excitations and ionisations, as also manifold other excitations can take place. [See following Abstract.] J. J. S.

3898. Excitation of Inert Gases by Collision with Inert Gas Ions. W. Weizel. *Zeits. f. Physik*, 76. 3-4. pp. 258-259, May 31, 1932.—The observations of Güntherschulze and Keller [see Abstract 851 (1932)] on the excitation of inert gases in canal rays are explained on theoretical grounds. A qualitative explanation can be given by the application of the collision mechanism assumed by Weizel and Beeck [see preceding Abstract]. The investigations show that inert gases can be excited by alkali ions at lower velocities than by their own ions. This is what may be expected. The colliding system Ne, Ne^+ , for example, possesses an electron less than the system Ne, Na^+ . J. J. S.

3899. Dissociation of Molecular Ions by Collision. E. Friedländer, H. Kallmann, W. Lasareff and B. Rosen. *Zeits. f. Physik*, 76. 1-2, pp. 60-69, May 12, 1932.—The products of the collisions of fast-moving molecular ions are investigated using the mass-spectrograph [see Abstract 2639 (1930)]; CO^{++} ions dissociate spontaneously into C^+ and O^+ ions. By collisions amongst themselves they dissociate into C and O^{++} ions. CO^+ dissociate into C^+ and O , NO^+ into N and O^+ , NO_2^+ into NO^+ and O and NO_2^{++} into NO^{++} and O . [See following Abstract.]
A. C. M.

3900. Collisions of Slow Electrons in Gases. E. Friedländer, H. Kallmann, W. Lasareff and B. Rosen. *Zeits. f. Physik*, 76. 1-2, pp. 70-79, May 12, 1932.—Doubly charged molecular ions occur in positive rays in various gases. The production of such ions is investigated by combining an electron-collision tube with a mass spectrograph [see Abstract 2639 (1930)]. Doubly charged ions are found in CO , CO_2 , NO and NO_2 . The ions are metastable; the voltages required to produce them are greater than the dissociation energies of the singly-charged ions. Doubly-charged ions were not found in N_2 or O_2 . [See preceding Abstract.]
A. C. M.

3901. Collision of Slow Electrons with Atoms. Part I. General Theory of Elastic Collisions. H. S. W. Massey and C. B. O. Mohr. *Roy. Soc., Proc.* 136. pp. 289-311, May 2, 1932.—Shows that even the theory of Born, using the new quantum mechanics, fails, in the first approximation, to explain the Ramsauer effect; and neglects the disturbance of the electron waves by the field of the scatterer, and the possibility of exchange of electrons between the atoms and the colliding beam. The authors show that below 20 volts the exchange effect clearly cannot be neglected, and up to 50 volts it exerts an appreciable influence on the scattering. In the theory as developed by the authors the zero approximation is not a plane wave, but the wave representing the motion of the electron in the static field of the atom concerned. The elastic scattering in H and He is considered in detail, and the effect of electron exchange is included throughout. Exchange does not become very important until lower voltages are obtained than on Born's theory, using the plane wave as first approximation. At these lower voltages, however, strong interference effects occur between the incident and exchanged electron waves, giving peculiar angular distributions of the scattered electrons. These effects have been observed experimentally.
H. N. A.

3902. Collisional Friction on Electrons Moving in Gases. E. C. Childs. *Phil. Mag.* 13. pp. 873-887, May, 1932.—Contains a study of the electrical conductivity of ionised gas when h.f. alternating electric fields are impressed upon it. The experiments involved the use of Langmuir's probe-current method of analysis since this yields information both on the electron concentration and on the electron temperature. The results show that the frictional coefficient of electrons moving in air is not very different from the value calculated from kinetic theory, and is at least of the same order. Hence any calculation of the behaviour of the Heaviside layer based on this assumption is not appreciably incorrect.
H. L. B.

3903. Collisional Friction on Vibrating Electrons in Ionised Air. E. V. Appleton and F. W. Chapman. *Phys. Soc., Proc.* 44. pp. 246-254; *Disc.*, 254, May 1, 1932.—The variation of the radio-frequency conductivity of ionised air with pressure has been studied experimentally
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at frequencies of the order of $10^9 \sim$. From the measurements of the critical pressure at which such conductivity is a maximum the magnitude of the collisional frictional forces experienced by vibrating electrons has been estimated. AUTHORS.

3904. Electron Diffraction and Molecular Structure, Part II. R. Wierl. *Ann. d. Physik*, 13. 4. pp. 453-482, May 4, 1932.—It is shown that the method described earlier [see Abstract 2786 (1931)] for studying the diffraction of electrons by molecular vapours may also be applied to the analysis of complicated molecules and particular structural questions. The distances between the atoms and their angular relationships are discussed for the substances: cyclopentane, ethane, ethylene, allene, acetylene, diacetylene, cyanogen gas, propane, butane, pentane, hexane, butadiene, cis- and trans-dichloroethylene, 1, 2-dichloro-ethane, 1, 2-dibromo-ethane.

H. L. B.

3905. Electron Diffraction at Single Crystals. J. J. Trillat and T. v. Hirsch. *Zeits. f. Physik*, 75. 11-12. pp. 784-803, May 6, 1932.—The diffraction of 40 kV-electrons at hammered gold and platinum foil has been investigated, and a pronounced fibrous structure found (fibre-axis perpendicular to plane of foil). In addition to Debye-Scherrer circles, single crystal diffraction images were observed, and the essential influence of the plastic deformation of the crystals for the production of these diffraction figures is discussed and experimentally established by thermal treatment. Experiments are also described which have enabled a valid decision to be made between surface-lattice and space-lattice interference, and indicate as a conclusion that space-lattice interference is the cause of the diffraction phenomena [see Abstract 2098 (1932)]. H. H. Ho.

3906. Determination of h/e by Means of the Diffraction of Electrons by a Gold Lattice. R. v. Meiborn and E. Rupp. *Ann. d. Physik*, 13. 6. pp. 725-731, May 21, 1932.—On the basis of the de Broglie relation the magnitude h/e is arrived at, by means of a direct measurement of the velocity of the electrons by the Wiechert-Kirchner method, combined with a determination of the electronic "wave-length" from the bending or diffraction of fast electrons of about 50 kV by a gold lattice. The value $h/e = 1.3798 \times 10^{-17}$ was obtained, with a mean error of ± 3.1 per thousand. H. N. A.

3907. Formation, Estimation and Absorption of Slow Neutral Rays. H. Kallmann, W. Lasareff and B. Rosen. *Zeits. f. Physik*, 76. 3-4. pp. 213-225, May 31, 1932.—A method is described for the production by means of transference of slow neutral rays of homogeneous velocity (30 to 800 volts), and the measurement electrometrically of their relative intensity. With this object the liberation of electrons from metal surfaces by means of neutral particles is utilised. The liberation coefficient in dependence on the velocity is determined and its absolute value roughly estimated. The absorption curves of argon rays in some gases were obtained. The transfer process was studied in some special cases with the help of this neutral-ray method. J. J. S.

3908. Surface Heating by Neutralised Positive Rays before and after Return to Normal State. M. C. Johnson. *Phys. Soc., Proc.* 44. pp. 255-265; *Disc.* 265-266, May 1, 1932.—A nearly parallel beam of positive rays emerges through a cylindrical aperture in a cathode, and

enters a space where the vacuum is kept high enough for gas collisions to be negligible. Experiments are carried out to decide whether the impact of neutralised atoms in the beam is able to heat a solid target to the same extent before and after their spontaneous return from excited to normal atomic state. This is done by investigating the disturbance of a bridge balance between two filaments accurately aligned across the beam at different distances along its path. With the aid of control experiments, and after elimination in the bridge of all effects common to the two wires, an excess heating is shown to occur in that filament which receives the larger proportion of atoms in excited states. The variation of this excess heating with the potential driving the discharge is found to be quantitatively in agreement with the variation of concentration of excited atoms at the different distances along the beam: this latter is calculated from Wien's experiments on the exponential decay of excited states along the path of neutralised positive rays. AUTHOR.

3909. Effect of the Target on Breakdown in Cold Emission. W. H. Bennett. *Phys. Rev.* 40. pp. 416-424, May 1, 1932.—By application of a magnetic field in a certain way, the effects of the target on emission of electrons from a cold cathode could be separated from the effect of conditions characteristic of the cathode surface. Observations show that the condition of the anode has a large effect on breakdown. AUTHOR.

3910. Emission of Negative Electricity from Nickel when Bombarded by Positive Lithium Ions. W. S. Stein. *Phys. Rev.* 40. pp. 425-428, May 1, 1932.—A nickel target was bombarded with positive lithium ions and observations were made of the number of negative charges emitted per positive ion striking the target. The energies of the bombarding ions were within the ranges 1000 to 2000 electron-volts and 5000 to 20,000 electron-volts, approximately. Observations were made with the target at room-temperature and at a yellowish-red heat. There is a marked difference between the curves found for the two cases. For the cold target the curve has a maximum between 10,000 and 11,000 volts, while the number of negative charges emitted per positive ion from the hot target increases from 0.13 at 1000 volts to 2.35 at 20,000 volts, no maximum having been found. AUTHOR.

3911. Deviation of Anode Currents in Diodes from the Three-Halves Power Law. A. Gehrts. *Phys. Rev.* 40. pp. 434-439, May 1, 1932.—Deviations from the law that the electronic emission from a hot filament is proportional to $V^{3/2}$, where V is the applied anode voltage, were noted by Kato, who regarded the deviation as a result of initial electronic velocity. Later Schottky investigated the matter and showed that the discrepancy was probably due to a combination of factors. Certain of Schottky's results are criticised in the present paper, notably in connection with the use of the space-charge equation, and by a somewhat different method a new $I - V$ equation is derived. G. E. B.

3912. Thermionic Emission during the Catalytic Combination of Carbonic Oxide-Oxygen Mixtures on a Platinum Surface. B. W. Bradford. *Chem. Soc., J.* pp. 1544-1560, May, 1932.—Although preliminary experiments have indicated that the catalytic combination of a gaseous mixture of the composition $2CO + O_2$ on nickel, gold, platinum and other surfaces was, in every case, accompanied by the emission of positive ions, it has not been possible in the case of platinum to establish

any wide quantitative proportionality between the rates of reaction and the corresponding emission currents. Although the catalytic activity of the metal ceased to change after a short period of normalisation, the magnitude and behaviour of the thermionic emission continued to pass through complex changes for some time. A possible explanation is that while the catalytic reaction is to a great extent determined by gas deeply occluded in the metal, the thermionic emissivity is largely dependent on the condition of the superficial layers. The occurrence of enhanced emission unaccompanied by measurable combustion lends support to this view. H. H. Ho.

3913. Photoconductivity and Catalysts. F. H. Constable and A. F. H. Ward. *Faraday Soc., Trans.* 28. pp. 497-508, May, 1932.—Tries dissolving various substances in selenium to see whether they affect its light-sensitive properties through their action as catalysts. The substances are silver, lead, copper, mercury, zinc, bismuth, thallium and iron. The general conclusion is that these foreign bodies play little part in assisting or retarding the ejection and recombination of electrons under the action of light, but they do determine the constitution of the crystalline light-sensitive mass. E. E. F. d'A.

3914. Effect of Adsorbed Gases on the Photoelectric Emissivity of Iron and Platinum. A. K. Brewer. *Am. Chem. Soc., J.* 54. pp. 1888-1900, May, 1932.—Investigation of the photoelectric properties of Fe and Pt in presence of various gases shows that the metals do not exhibit the characteristic properties of a metal under good vacuum conditions but manifest rather the properties of composite surfaces, as their behaviour is similar to that of the metals *in vacuo* and partly covered with adsorbed ions. The results of experiments on surfaces of known ion-density indicate that the large field of force about the adsorbed ions may account for the phenomena generally attributed to active centres and that the large effect of adsorbed ions on the work function of the surface may be responsible for poisoning and promoter action. The observed ionisation of N, H and NH_3 on Fe and Pt surfaces is shown to be in accord with an ionic mechanism for surface catalysis and with the activation results obtained in the glow discharge. T. H. P.

3915. Electrical Behaviour of Boundary Layers. H. Teichmann. *Ann. d. Physik*, 13. 6. pp. 649-680, May 21, 1932.—This paper investigates the possible electronic processes between metals, partial conductors and insulators, and first discusses the properties of stop-boundary layers. A working hypothesis is then proposed which connects the structure of stop-layers with the crystal structure of the material, and the stop-layer is compared with a system of funnels, analogous to the conception of electric field funnels. This new hypothesis allows the anticipation of a selectivity of the stop-layer photoelectric effect with respect to the polarisation of the released light. Experimental confirmation of the theory is afforded by means of a freshly prepared selenium-potassium layer. It is finally indicated that the Fowler theory of the selective photoelectric effect implicitly contains an explanation of the stop-layer phenomenon based on wave-mechanics which is compatible with the above field-funnel hypothesis. H. H. Ho.

3916. Compound Photoelectric Effect of X-Rays in Light Elements. G. L. Löcher. *Phys. Rev.* 40. pp. 482-495, May 15, 1932.—The K fluorescence yields of O, Ne and A have been found from the numbers

of double photoelectron tracks (produced by auto-ionisation), and the numbers of single tracks, on 1950 stereopictures made in a Wilson cloud chamber, with atmospheres containing small amounts of the gases under investigation. From the data of this experiment and the K absorption data collected by Wien and Harms, the yields are: O 8.2 %, Ne 8.3 % and A 14.9 % for 0.709 Å. X-rays. The K yields previously found for heavier elements by A. H. Compton, M. I. Harms and L. H. Martin, and those given here, mostly lie on a smooth curve. Auger's value for Kr seems to be 13 % too low, and that for A at least 45 % too low. The most probable values of the K yields of 47 elements are given, as percentages of the K quanta that escape from K ionised atoms. The L yield of A is estimated to be between zero and 20 %, on the basis of the number of tracks counted. A new type of double track has been observed; its components are of similar energy, but produce very unequal ionisation. They are believed to be due to Kr atoms with metastable lives of the order of 0.01 sec. The cloud method can be used for detecting heavy gases in light ones. It is shown that 15 parts of Kr in 10^6 of O, or 50 parts of Xe in 10^6 of O, will give 2 % of characteristic double tracks due to the heavy element.

AUTHOR.

3917. Photoelectric Cells with Thin-Layered Alkali Kathodes.

R. Sewig. *Zeits. f. Physik*, 76, 1-2, pp. 91-105, May 12, and 77, 5-6, p. 420, Aug. 2, 1932.—Describes technical improvements in the preparation of photoelectric cells, with monatomic layers of alkali metals. The method given by Asao and Suzuki, using diffusion cathodes, for increasing the sensitiveness of photoelectric cells is studied in the cases of a large number of the heavy metals. The discussion of the results leads to the conclusion that the action of the diffusion cathodes depends less on a lowering of the exit work than in an increase in the optical absorption.

H. N. A.

3918. Light-Sensitive Cells. F. H. Constable.

Roy. Soc. Arts, J. 80, pp. 629-648; *Disc.*, 648-653, May 13, 1932.—Describes the leading types of photoelectric devices now in use, with some of their applications. Distinguishes three main types: (1) photo-conducting cells, (2) photoelectric cells, (3) photovoltaic cells. Of the first group, comprising selenium cells and the like, he describes in detail the Radiovisor cell, which has a gold grid on glass and is immersed in an inert gas. This cell is used for race-timing, counting, sorting and burglar alarms. The author reproduces a number of records of daylight obtained with photoelectric cells. The cell most suitable for this work is a gasfilled caesium-on-silver-oxide cell, which has a spectral response very similar to the human eye.

E. E. F. d'A.

3919. Blocking-Layer Selenium Cells. F. v. Korösy and P. Selényi.

Ann. d. Physik, 13, 6, pp. 703-724, May 21, 1932.—The authors consider the "blocking-layer cells" which may be regarded as a parallel combination of a photoelectric cell, a rectifier and a condenser, with a resistance in series with the combination. They have made numerous experiments, all of which have corroborated this model. With selenium blocking-layer cells, which are on the whole the best, they find that the current on short-circuit increases with the light intensity, but finally approaches a limiting value. At the same time the external resistance has to be diminished to get the maximum efficiency.

E. E. F. d'A.

3920. Measurements with Photoelectric Relays. R. B. Barnes and F. Matossi. *Zeits. f. Physik*, 76. 1-2. pp. 24-37, May 12, 1932.—The photoelectric relay method for the magnification of small displacements has been investigated with satisfactory results and has been applied to infra-red measurements. A Moll linear thermopile with Zernike galvanometer (type Zb) were used as radiation-receiver and so arranged that only the Brownian movement remained as a disturbance. The reflection power of water was measured with a magnification of 4500 and found to give two reflection maxima. H. H. Ho.

3921. Influence of Diffused Light on Photoelectric Measurements. T. D. Gheorghiu. *Comptes Rendus*, 194. pp. 1810-1813, May 23, 1932.—A long series of experiments upon the measurement of the absorptive powers of photoelectric cells has shown that the diffusion of light may entail serious errors. H. H. Ho.

3922. H.F. Oscillations Made Visible by Means of Electrodeless Glow Discharge. F. Herold. *Phys. Zeits.* 33. pp. 418-419, May 15, 1932.—Describes a method in which the positions of nodes and loops, when h.f. oscillations take place in long coils, are made visible by differently coloured lights of a single gas, under definite experimental conditions. The method is particularly adapted for lecture experiments in large lecture rooms. An evacuated glass tube is placed close to and parallel with the long coil experimented with, and particulars are given of the luminous phenomena observed in this tube. H. N. A.

3923. Temperature of a Piezoelectric Crystal as a Function of its Vibration. A. de Gramont and D. Beretzki. *Comptes Rendus*, 194. pp. 1777-1778, May 23, 1932.—It is shown that an oscillating crystal may have a high temperature as a result of the oscillations, this being unaffected by thermostat arrangements, etc. If a crystal can vibrate at two or more frequencies, as sometimes happens with impure specimens, it is found that there are two different crystal temperatures. In one case in which the temperature was measured by means of a thermocouple attached to one of the condenser plates, a temperature of 140° C. was observed. G. E. B.

3924. Plasma Oscillations and Selective Optical Reflection of Metals. M. Steenbeck. *Zeits. f. Physik*, 76. 3-4. pp. 260-265, May 31, 1932.—A volume which is uniformly filled with free electrons and as many positive ions exhibits throughout no effective space charge. Such a medium is called "plasma" by Langmuir. The plasma oscillations calculated by Langmuir and Tonks and observed in the positive column of vacuum arcs are transferred to the electron gas in metals without consideration of the gas degeneration. Frequencies corresponding to $\lambda = 2000 \text{ \AA.}$ are found. For this frequency which is characteristic of the metal as a whole, a selective reflection and absorption maximum is to be expected, as is also actually observed. If the reflection maximum is in fact traced back to the space-charge oscillations of the electron gas the reflection maximum should only occur for light whose electric vector vibrates in the incident plane whilst light polarised at right angles thereto should not show this phenomenon. [See Abstract 1637 (1929).] J. J. S.

3925. Magnetic Properties of Manganese and Chromium Dissolved in Solids. L. Néel. *J. de Physique et le Radium*, 3. pp. 160-171, April, 1932.—The author shows that Mn dissolved in solid Cu or Ag and

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Cr dissolved in solid Au have a paramagnetism which obeys Weiss' law. The Curie constants are proportional to the quantity of Cr or Mn. Under these conditions the moment of the Cr is 23.47 Weiss magnetons. The author reviews the lines along which it should be possible to find an interpretation of paramagnetism independent of the temperature. H. L. B.

3926. Magnetic and Crystal Properties of Copper and Iron Sulphides. L. Cambi and L. Szegő. *Accad. Lincei, Atti*, 15, pp. 599-602, April 17, 1932.—Complex sulphides of the approximate compositions $K_3Fe_3Cu_4S_7$, $K_3Fe_2Cu_5S_7$ and $K_5Fe_3Cu_{11}S_{14}$ have been prepared. All form tetragonal crystals with an axial ratio $c:a$ of 1.182, and are paramagnetic, the susceptibility in the case of $K_3Fe_2Cu_5S_7$ corresponding with 28.1 magnetons per iron atom. $KFeS_2$, which is paramagnetic at $-80^\circ C.$, is diamagnetic at $-190^\circ C.$; the susceptibility of sulphides containing iron and copper passes through a minimum at about $98^\circ A.S.$ H. F. G.

3927. Magnetic Properties of Iron, Nickel, Cobalt and their Alloys at High Temperatures. H. Kühlewein. *Wiss. Veröff. a. d. Siemens-Konzern*, 11, 1, pp. 124-140, 1932.—The magnetic properties of Fe, Ni, Co and several of their alloys at high temperatures are determined experimentally, the material being in the form of test samples cast as rings. It was found that two Curie points, *vide* Forrer, existed for Fe, Ni and an Fe-Ni-Co alloy, of which the structure corresponds to a cubic lattice. The paramagnetic Curie temperature is greater than the ferromagnetic Curie point. The view of Forrer, that for definite Fe-Co alloys the paramagnetic Curie point is less than the ferromagnetic, is not established. At temperatures over $500^\circ C.$ permivar is shown to behave as monocrystalline. The change from the hexagonal structure to the cubical lattice centred in a single plane as indicated above is shown to be influenced by the existence of an external field, for Co alloys. S. G. B.

3928. Torsion Modulus of Nickel under Simultaneous High Temperatures and Magnetisation. W. Möblus. *Phys. Zeits.* 33, pp. 411-417, May 15, 1932.—The alteration of the elastic constants of ferromagnetic crystals at the Curie point is determined in the present work for a nickel wire so treated. The relationship between the mechanical consequences and the alteration of the valency forces is established according to Heisenberg. The modulus of the effect of a magnetic field along its length is measured, and shows that with increasing temperature a minimum value is first reached, after which it proceeds to a maximum and finally assumes a linear relationship. The variation of the agreement or proportionality between the modulus and increasing field strength is extremely small over this linear range, which lies beyond the approximate Curie point, whilst if the alteration of valency forces were responsible then it would not be smaller but very much greater. According to the present investigations the behaviour of the elastic constants of ferromagnetic materials at the Curie point is not affected by any changes in the valency forces, but in this range all phenomena are accounted for by magnetostriction. Experimental details are given. S. G. B.

3929. Magnetic Susceptibilities of Nickel Compounds. R. A. Fereday. *Phys. Soc., Proc.* 44, pp. 274-280, May 1, 1932.—The susceptibilities of a number of compounds of nickel in the solid state have been measured at room-temperature. The atomic susceptibility of combined nickel is found to remain constant, except in the cases of the anhydrous

cyanide and of dioxime compounds. Some of the latter are diamagnetic. [See Abstract 3244 (1930).] AUTHOR.

3930. Constitution and Paramagnetism of Crystalline and Gaseous Ferric Chloride. A. Lallemand. *Comptes Rendus*, 194. pp. 1726-1727, May 17, 1932.—Fe in ferric chloride has a magnetic moment of 27.99 Weiss magnetons. The molecular susceptibility ($\times 10^3$) of ferric chloride drops from 9.98 at 125° to 4.59 at 327° C., is then constant to 430°, and then decreases again. The change above 125° is due to formation of gaseous Fe_2Cl_6 , that at 430° to dissociation to FeCl_3 . In the molecule Fe_2Cl_6 the two atoms of Fe have the same valency; they are coupled directly and are antiparallel. C. A. S.

3931. Correlation of the Gyromagnetic Ratio and the Magnetic Moment of Paramagnetic Salts. E. C. Stoner. *Leeds Philosoph. and Lit. Soc., Proc.* 2. pp. 309-318, April, 1932.—The question of the interaction between neighbouring ions is discussed in the light of recent work by Sucksmith and others. The experimental results for the magnetic moments expressed as a p value of the ions of the first transition series (i.e., with from 19 to 27 electrons) are collected, together with the results for the gyromagnetic ratios for salts containing these ions. For three ideal limiting cases the p and g values are also calculated corresponding to close coupling of the spin (s) and the orbital moment (l) vectors, to independent s and l , and to suppression of the l moment. It is shown that the g values are in good accord with the general interpretation given in the paper of the p values and that on this basis the p and g values are compatible with each other. The values observed, also their variability for the same ion, may be explained in terms of the partial, or complete, independence of the s and l moments, and of the partial, or complete, ineffectiveness of the l moment owing to interaction. S. G. B.

3932. Atomic Moments and Curie Points of the Ferro-Silicons. M. Fallot. *Comptes Rendus*, 194. pp. 1801-1803, May 23, 1932.—Gives a detailed account, illustrated by a graph, of the relations between the magnetic properties of these alloys. H. N. A.

3933. Magnetostriction of a Circularly Magnetised Bar and its Applications. S. Mori. *Imp. Acad. Tokyo, Proc.* 8. pp. 151-154, May, 1932. *In English*.—The twisting of a circularly magnetised bar creates magnetic flux by magnetostriction. In the present paper such bars are prepared by giving mechanical shocks to bars through which a direct current is flowing. Bars so prepared from nickel and various types of steel are used for the measurement of mechanical forces which vary rapidly, or for an indicator of transverse or torsional vibrations, e.g., the torsional vibrations of a rotating shaft. S. G. B.

3934. H.F. Permeability. W. Arkadiew. *Ann. d. Physik*, 13. 5. pp. 636-640, May 13, 1932.—Reply to criticisms by M. Wien [see Abstract 1397 (1932)] of the author's work. S. G. B.

3935. Effect of Hysteresis upon the Heat Developed by an Oscillating Magnetic Field. A. Blondel. *Comptes Rendus*, 194. pp. 1700-1703, May 17, 1932.—The work is a mathematical discussion of the extension of the theory of the creation of heat in a metallic cylinder by an alternating field parallel to its axis to the case where the metal is magnetic and the effect of hysteresis has to be recognised. Such an effect

results in general in an augmentation of the real power consumed. A relationship is deduced between the effect and the hysteresis angle introduced in electricity by Steinmetz. *Errata, ibid.*, p. 2364, June 27, 1932.

S. G. B.

3936. Magnetism of Free Electrons. L. Posener. *Zeits. f. Physik*, 75. 11-12. pp. 809-811, May 6, 1932.—The magnetism of free electrons, taking into account electronic spin-energy, is discussed, along lines initiated by Landau [see Abstract 989 (1931)]. The value of the paramagnetic moment due to spin is found to be $(\mu^2 H \partial N / \partial \omega) / 4$, H denoting the field strength, N the number of particles concerned, ω the chemical potential and $\mu = eh/mc$. For an electron gas the paramagnetic susceptibility is about $2/3$ that attributable to spin. J. S. G. T.

3937. Derivation of Maxwell's Equations from the Equations of the Quantum Theory. M. Fahmy. *Phys. Soc., Proc.* 44. pp. 368-373, May 1, 1932.—In a theory developed by Flint and Fisher [see Abstract 2745 (1930)] the fundamental equations of the quantum theory are expressed in terms of a five-dimensional geometry based upon the use of two inter-related tensors A and B. In the present paper Maxwell's equations are derived from the five-dimensional equations previously proposed, and the tensors A and B are exhibited as geometrical quantities related to the electromagnetic potential. AUTHOR.

3938. Electromagnetic Waves and Pulses. W. E. Sumpner. *Phil. Mag.* 13. pp. 1049-1075, May, 1932.—The apparent conflict between the principle of the independence of waves based on the experimental fact that radiation waves can cross each other's path, or travel together, without interfering, and the doctrine of interference is discussed. Poynting's theorem is proved, using Heaviside's vector methods and Heaviside's form of Maxwell's equations. Heaviside's extended form of the energy flux, discovered independently of Poynting, apparently insists on the independence of disturbances. The Poynting energy fluxes, separately calculated, may, for some purposes, be added, but never form a single flux. The fluxes involved in radiation are discussed, employing an illustration first suggested by Poynting. The properties of pulses suggest that light is to be regarded as corpuscular in character rather than undulatory. An isolated pulse of light incident on a surface separating two different media is shown to split up into two pulses obeying the ordinary laws of reflection and refraction. An isolated pulse behaves like a complete wave when reflected or refracted. A ray of light is conceived to exist in a neutralised state, so that it has no observable effect on matter though it conveys electromagnetic energy. The "principle of reversibility" in regard to light does not appear to hold with light on the theory of Maxwell extended by Poynting's theorem. J. S. G. T.

3939. Motion of a Charged Particle. Part III. C. Störmer. *Zeits. f. Astrophysik*, 4. pp. 290-318, May 30, 1932.—Further series expansions of the integrals of the equations of motion are given. A study is made of the very approximate integrals which hold at great distances from the dipole and the constants of integration are found which agree with the initial conditions. Applications of the results are made to motion under no forces, gravitation and the case where a dipole occurs alone. [For Part II see Abstract 603 (1932).] H. L. B.

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APPARATUS AND INSTRUMENTS.

3940. New Mass Spectrometer. W. R. Smythe and J. Matthauch. *Phys. Rev.* 40, pp. 429-433, May 1, 1932.—A new type of mass spectrometer has been constructed in which no magnetic fields are used. By applying an alternating electric field at right angles to the beam of positive particles all but certain velocities are removed from the beam. Because of the fact that a symmetry not contemplated in the theory previously published was introduced in the construction for mechanical reasons, the apparatus transmits some other velocities besides those desired. This produces extra peaks and complicates the mass spectrum. Because of this and the fact that the apparatus is badly contaminated with mercury from the diffusion pumps in spite of the continued use of liquid air, a new apparatus is designed in which, it is expected, both effects will be eliminated. Comparison of the peak at 32 with that at 34 gives a maximum ratio of the intensity of $O^{16}O^{18}$ to $O^{16}O^{18} + (Hg^{204})^{6+}$ of 300. This is presumably the ratio with the smallest contamination of mercury and means that the ratio of O^{16} to O^{18} is greater than 600. AUTHORS.

3941. Thermo-Relay Amplifiers. C. H. Cartwright. *Rev. Sci. Instruments*, 3, pp. 221-224, May, 1932.—The thermo-relay amplifier is activated by the image reflected from the mirror of the primary instrument whose deflections are to be determined. The amplified deflections are determined either visually or photographically by a secondary galvanometer connected directly with the thermo-relay. The amount of amplification is controlled by the intensity of light from the reflected filament, which falls upon two wedge-shaped receivers of blackened gold foil having thermo-junctions waxed or soldered on to them. An amplification of 100 is secured, with a time of 2 sec. to reach equilibrium. E. E. F. d'A.

3942. Electrolytic Resistors of High Resistance. H. L. White and E. A. van Atta. *Rev. Sci. Instruments*, 3, pp. 235-238, May, 1932.—Resistances of from 1×10^8 to 3×10^{10} ohms have been obtained by sealing capillary bridges (inside dia. 0.005 to 0.088 mm.) between calomel electrodes made up with dilute KCl-saturated calomel solutions. These resistors can be used satisfactorily with an electrometer or sensitive galvanometer and condenser set-up. They do not exhibit polarisation and their resistances do not change with age. The temperature coefficient is that of the KCl solution used in the preparation of a resistor.

AUTHORS.

3943. Sensitive Electroscopes. C. Lukens. *Rev. Sci. Instruments*, 3, pp. 239-247, May, 1932.—Three electroscopes are described whose electrodes are: (I) a single fibre repelled from a forked wire, (II) a Schonland electrode hollowed to increase the sensitivity, (III) a Schonland electrode, also hollowed, but with the mirror hung on a single gold leaf suspension and rotating on a nearly vertical axis. The deflections produced by the emission of an α -particle, as a consequence of which about 10^5 ions were collected, were approximately: for type I, 5 eyepiece scale divisions; type II, 7 mm.; type III, 20 mm. A method is given for determining the charge sensitivities of certain electroscopes. AUTHOR.

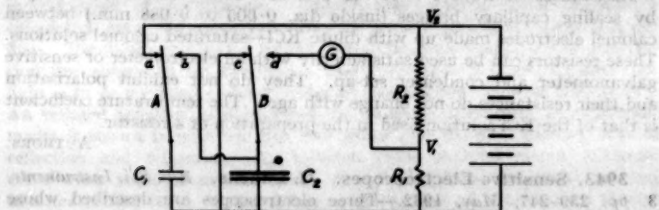
3944. New Tilted Electrometer. H. Carmichael. *Phys. Soc., Proc.* 44, pp. 400-406; *Disc.* 406-407, May 1, 1932.—A description is given of the construction and performance of a new electrometer on the

principle of the Wilson tilted gold-leaf electrometer. The instrument has a quartz fibre "leaf" which moves in hydrogen to reduce sluggishness. There is complete protection of the instrument from atmospheric disturbance, and considerable simplifications are made in the construction and in the method of adjustment. Typical sensitivities of 3 mm. and 30 mm. fibre movement per volt (linear for 2 mm. and 1 mm. respectively) have been obtained, and a reliable eyepiece scale sensitivity of 1000 divisions per volt is within the range of the instrument. AUTHOR.

3945. Vacuum H.T. Contact-Breaker. G. Vaudet. *Comptes Rendus*, 194. pp. 1637-1639, May 9, 1932.—The apparatus described is based upon Paschen's law concerning explosive potentials. H. H. Ho.

3946. Method of Comparing Small Capacities. M. Durepaire. *Comptes Rendus*, 194. pp. 1902-1904, May 30, 1932.—The method makes use of the fact that a condenser, charged by means of a battery and discharged through a neon tube and a resistance, gives an oscillatory current, the frequency of which depends, among other things, on the value of the capacity. The circuit constants are chosen to give an oscillation of audible frequency, which can be heard in a telephone. By means of a commutator, arrangements are made for the condenser under test, and a standard variable condenser to be charged and successively discharged through the tube; there is heard in the telephone a musical note of varying pitch, unless the two condensers have the same capacity. By varying the standard condenser to give equality of pitch, the capacity of the test condenser can be found. Should the test condenser be leaky, this difficulty can be overcome by inserting a good quality condenser in series. G. E. B.

3947. Method of Measuring Small Capacities. J. A. van den Akker. *Rev. Sci. Instruments*, 3. pp. 225-229, May 1932.—A modification of a method already described [see Abstract 3245 (1931)] for the



measurement of small capacities or high potentials, in which the arrangements are simplified in the method of measuring capacity. The circuit is arranged as in the diagram, in which C_1 and C_2 are the condensers, and A and B are vibrating metal tongues. G is a sensitive galvanometer, and A and B are vibrating metal tongues. In action, starting with the tongues as shown, C_1 is charged, and C_2 discharged. A short time later the tongues make contact with b and d, the condensers arrive at a common potential, and in general the galvanometer shows a deflection when, an instant later, tongue B makes contact with a. By varying the ratio of $R_2 : R_1$, balance can be established, in which case $C_1 : C_2 :: R_1 : R_2$. G. E. B.

3948. Measurement of Ionisation Currents by Means of an A.C. Bridge and Valve Amplifier. J. Ewles. *Leeds Philosoph. and Lit. Soc., Proc.* 2. pp. 267-270, Jan., 1932.—The ionisation chamber forms one arm of an a.c. bridge, the other arms being balanced by condensers. The balance is detected in a very sensitive way by applying the bridge to the input of a multivalve amplifier, the output of which is connected through an output transformer to a rectifier and galvanometer. The balance having been obtained, the application of the ionising radiations disturbs it, and either the balance current shown in the galvanometer is taken as a measure of the ionisation or a null method is used in which the balance is restored by means of a resistance in series with the capacity in the arm complementary to the ionisation arm. Measurements with the null method on a radioactive source show that the value of the balance restoring resistance is strictly proportional to the ionisation, as theory indicates. A magnification of 10^8 or more is obtainable. J. E.

3949. Simplified Automatic Wilson Chamber. L. F. Curtiss. *Bureau of Standards, J. of Research*, 8. pp. 579-582, May, 1932.—A description of a simplified form of exhaust or vacuum-type Wilson cloud chamber, built for demonstrating ray tracks, is given. No vacuum pump or quick-acting valve is required. By introducing some refinements this design seems adaptable also to the automatic photography of ray tracks.

AUTHOR.

3950. Thyatron "Scale of Two" Automatic Counter. C. E. Wynn-Williams. *Roy. Soc., Proc.* 136. pp. 312-324, May 2, 1932.—The author has previously shown that thyratrons, consisting of suitable triode-valves, can be associated with a mechanical counting meter, and made to record continuously events separated by time intervals very much shorter than the time required by the mechanical meter to effect its own changes of dial readings. A special "thyatron-ring" circuit was used, containing a group of four or five thyratrons, for high-speed counting of α -particles. The author has since been able to develop a new type of circuit, which is very much simpler in construction, and needs no critical adjustments. All current supplies can be taken from the laboratory mains. Several units of two thyratrons are arranged in cascade, so as to reduce the rate of counting by a factor of 2 per unit. For most purposes four or six thyratrons should suffice. H. N. A.

3951. Indicator for Geiger-Müller Counter. R. Jaeger and J. Kluge. *Zeits. f. Instrumentenk.* 52. pp. 229-232, May, 1932.—Describes an arrangement for recording the number of impulses received in a Geiger-Müller tube counter. It utilises a thyatron to operate an ordinary electromagnetic counter. J. H. A.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

3952. Effect of Monochromatic Ultra-Violet Radiation on Euglena Cells. W. F. G. Swann and C. del Rosario. *Frank. Inst., J.* 213. pp. 549-560, May, 1932.—It is shown that the number of deaths of euglena cells under the action of ultra-violet light is dependent on the product of intensity and time, and within the limits of the experiment the same when the two factors were varied always keeping the product constant. The lethal action is strongly selective with varying wave-

length. Wave-lengths of 3654, 3132, 2894 and 2536 Å. were tried, 2536 showing considerable effect, 2894 much smaller and the other two no measurable effect. It was shown by ultra-violet microphotography that the lethal wave-lengths were strongly absorbed in the nuclei of the euglena cells while the other wave-lengths were not. Remarks by E. U. Condon, *ibid.*, 214. pp. 105-106, July, 1932. W. V. M.

3953. Quality of X-Rays and γ -Rays Scattered in Water. W. J. Rees and L. H. Clark. *Brit. J. of Radiology*, 5. pp. 432-444; *Disc.*, 444-445, May, 1932.—The quality of radiation scattered by water exposed to medium and penetrating X-rays, and to γ -rays, is measured. The conditions correspond approximately to clinical ones. For X-rays, using a copper thimble-chamber, it is found that the scattered radiation is considerably softer than the primary. This is attributed to multiple scattering. The ratio of the amount of scattered to that of primary radiation is measured under different conditions. In some cases only one-third of the total radiation is primary. Similar experiments carried out for γ -rays, although not so reliable, give similar results regarding the softer nature of the scattered radiation. J. T.

3954. Effect of Intense Diathermy on Plants. N. Marinisco. *Comptes Rendus*, 194. pp. 1387-1390, April 13, 1932.—Owing to a dissymmetry in the effects of electric fields on plants, in that an applied e.m.f. causes sap to mount more easily than to descend, a plant may be used as a rectifier. The paper describes experiments with h.f. fields on plants (250 W to 1.5 kW with wave-lengths of 3.10 to 600 m.). Audubert and Heim have shown that h.f. waves have a favourable action on the development of certain cereals. These and similar actions have been verified by the author and ascribed to the fact that such oscillations cause the sap to be forced upwards more abundantly. W. V. M.

3955. Prolonged Administration of Artificial Respiration. P. Drinker and L. A. Shaw. *Frank. Inst.*, J. 213. pp. 355-372, April, 1932.—Until 1928, artificial respiration was performed either manually (Schafer's method) or by means of a bellows. The defects of Schafer's method are mentioned and the bellows method has been discredited and abandoned. Thunberg devised a "barospirator" in which the patient is placed in a chamber, and the air pressure is raised and lowered, so that the patient breathes without actual movement of the chest. Note is also made of other attempts to devise particular apparatus for artificial respiration. The authors have devised an apparatus intended to overcome the intercostal paralysis of infants suffering from poliomyelitis. The method was first attempted in Jan., 1927, upon a cat. The original apparatus utilised household vacuum cleaners as the source of air pressure, but later apparatus has been developed and extensively supplied after specialised construction. Briefly summarised the apparatus consists of a large chamber, in which the body of the patient is placed, and subjected to changes of air pressure, whilst the patient's head and mouth is exterior to the chamber. It was found that the muscular work of breathing is only a small fraction of the total energy expended by the body. Interesting cases of practical use resulting in the extension and saving of patients' lives are discussed. The body is kept warm within the chamber by use of heating electric bulbs and, in recent models, the chambers can be rotated and tilted, so that the patient's head may be lowered, to prevent normal excretions from flowing downwards into the lungs. B. J. L.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

3956. Sorption of Gases by Iron. A. F. Benton and T. A. White. *Am. Chem. Soc., J.* 54. pp. 1820-1830, May, 1932.—The results are given for the isothermal sorptions of nitrogen, carbon monoxide and hydrogen by reduced iron at pressures up to one atmosphere and for temperatures down to -78°C . Reference is made to previously reported work on copper. Again it has been found that sorption generally involves three definitely distinguishable processes, (a) adsorption of the physical type, (b) adsorption of the activated type and (c) a third process which is probably solution. J. K.

3957. Inversion of Traube's Rule by Adsorption. E. Heymann and E. Boye. *Kolloid Zeits.* 59. pp. 153-157, May, 1932.—It is shown that the adsorption of fatty acids by gold from their aqueous as well as non-aqueous solutions decreases, although not quite regularly, with rise in the homologous series. J. K.

3958. Mechanism of Adsorption on the Surface of Heteropolar Crystals. B. Tezak. *Kolloid Zeits.* 59. pp. 158-162, May, 1932.—It is shown that a most important factor governing adsorption is the resemblance of the adsorbed with the crystal-constituting ions. Adsorption increases as this resemblance increases. For instance, for BaSO_4 the degree of adsorption of certain kations can be represented by the following series: $\text{Ba}^{++} > \text{Hg}^{++} > \text{Pb}^{++} > \text{Cd}^{++} > \text{Mn}^{++} > \text{Zn}^{++} > \text{Cu}^{++} > \text{Ni}^{++} > \text{Mg}^{++} > \text{Al}^{+++}$. Again, for BaSO_4 crystals in the presence of an excess of Ba ions the degree of adsorption of anions can be represented as follows: $\text{Fe}(\text{CN})_6^{4-} > \text{Fe}(\text{CN})_6^{3-}$; $\text{NO}_3^- > \text{Cl}^- > \text{Br}^- > \text{I}^-$. J. K.

3959. Gas-Solid Equilibria. Part IV. Pressure-Concentration Equilibria between Ferric Oxide Gels and (a) Water, (b) Ethyl Alcohol, (c) Benzene. B. Lambert and A. G. Foster. *Roy. Soc., Proc.* 136. pp. 363-377, May 2, 1932.—With methods and material as before [see Abstract 1792 (1932)] the system $\text{H}_2\text{O}-\text{Fe}_2\text{O}_3$ gel invariably evolved permanent gas when near saturation. "Water-treated" gel (i.e., evacuated gel two-thirds saturated with water vapour, heated for several hours at 148° and again evacuated) still evolved some gas. No such difficulty occurred with EtOH or C_6H_6 . With EtOH , especially with the "water-treated" gel, reproducible results were only obtained after repeated saturation and removal of EtOH . The isothermals for EtOH and C_6H_6 are quite similar, the absorption capacity for EtOH being slightly greater; but those for SiO_2 and Fe_2O_3 gels are very different, the isothermal for the latter rising much more steeply from the pressure axis as concentration of vapour increases (for half saturation with C_6H_6 at 50° "original" and "water-treated" Fe_2O_3 gel have equilibrium pressures $1/2$ and $6/7$ of that at saturation, while for SiO_2 gel it is only $1/80$). Only Fe_2O_3 gel shows hysteresis; this is a true equilibrium phenomenon, and not due solely to presence of permanent gas. C. A. S.

3960. Effect of Electrolytes on the Fixation of Colloidal Colouring Matter on Hydrosol Granules. M. Doladilhe. *Comptes Rendus*, 194. pp. 1934-1936, May 30, 1932.—It is shown that the intensity of
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action of an electrolyte, whether favourable or unfavourable towards fixation, dependent upon whether the ion of the electrolyte has an opposite charge to that of the granules of the hydrosol, and is therefore active towards flocculation, also depends on the degree of valency of the active ion. [See Abstract 3607 (1931).] J. K.

3961. Effect of Oxygen Concentration on the Adsorption of Electrolytes by Active Charcoal. O. Bretschneider. *Zeits. f. phys. Chem.* 159. *Abt. A*, pp. 436-440, May, 1932.—The results obtained are given for the adsorption of HCl by gas free, gas extracted and subsequently aerated, and aerated activated charcoal. Conclusions from these results are derived as to the mechanism of acid adsorption. J. K.

3962. Dynamics of Osmotic Cells. E. Manegold and K. Solf. *Kolloid Zeits.* 59. pp. 179-195, May, 1932.—It is pointed out that the laws of osmotic cells can so far not be expressed in mathematical form, but among the several important factors connected with osmotic cells it can be stated that whether a collodion membrane is permeable or semi-permeable is dependent on whether the molecules of the dissolved substance are smaller or larger than the diameter of the capillaries. Furthermore, if a particular osmotic cell has a semi-permeable nature, then the boundary for solution and water is always sharp and the concentration gradient in the boundary infinitely large. J. K.

3963. Explanation of Abnormal Osmosis at Non-Swelling Membranes. Part III. K. Söllner and A. Grollman. *Zeits. f. Elektrochem.* 38. pp. 274-282, May, 1932.—It is shown that abnormal osmosis [see Abstract 3268 (1930)] may be conditioned not only by the different widths of the pores of a membrane, but also by other heterogeneities of the membrane, in so far as these influence the dynamic membrane potential; attention is drawn especially to the mosaic structure of many membranes. New experiments in negative osmosis show that the heights of rise and the velocities with which they are attained far surpass those previously observed. In a special experiment, two dissimilar membrane diffusion chains, connected by electrolytic bridges, were arranged to act on one another, electroosmosis occurring at the one membrane, while the other showed electromotive activity. These conditions represent those of the mutual action of two different pores or parts of a membrane. The results observed appear to verify the theory previously outlined [*loc. cit.* and Abstract 2322 (1930)]. T. H. P.

3964. Diffusion and Passage of Gases into Liquids. Part II. Diffusion of Hydrogen through Colloidal and Liquid Membranes. R. Sandri. *Akad. Wiss. Wien, Ber.* 141. 2a. 1-2. pp. 81-101, 1932.—The validity of the Stefan-Fick diffusion theory, which is completely analogous to the Fourier theory of thermal conduction, is investigated for some cases of gaseous diffusion through colloidal and liquid partitions. [See Abstract 1209 (1930).] Experimental details with data are included which confirm (within limits of error) the above theory for hydrogen diffusing through soft rubber. Agreement is even better for membranes prepared from solutions of rubber in CS_2 . Gasfilled soap bubbles change their dimensions rapidly by gaseous diffusion through the soap lamellae but the above theory is still applicable. H. H. Ho.

3965. Dielectric Loss in Colloidal Systems. R. Köhler. *Kolloid Zeits.* 59. pp. 143-150, May, 1932.—The theory and practice of measuring the dielectric charge factor at high frequencies are outlined, and the use of such measurements is suggested for the qualitative investigation of alterations of state of polar organic liquids. According to Debye this factor, measured at constant frequency, has a maximum value at a definite temperature, the position of the maximum depending essentially on the magnitude of the particles and on the viscosity. For a mixture of colophony and nitrobenzene two such maxima, corresponding with the two components, are observed. The changes in state of a solution in xylene of condensation products of aniline and formaldehyde with heat-treatment have also been studied. Prolongation of this treatment is accompanied by diminution of the maximum value of the dielectric charge factor and by displacement of the maximum towards the region of higher viscosity. A possible interpretation of this behaviour is given. T. H. P.

3966. Solubility and Light Absorption of Colloidal Vanadium Pentoxide. B. Lange. *Kolloid Zeits.* 59. pp. 162-170, May, 1932.—It is shown that the light absorption of the molecular dissolved portion of colloidal V_2O_5 solutions is very small and thus the solubility and the rate of solution can thereby be determined. The effect of As_2O_5 is also determined by the light absorption. It is shown that As_2O_5 hardly alters the rate of solution, but the molecular soluble portion is increased. J. K.

3967. Action of Piezoelectric Oscillations on Sols and Suspensions. Ultrasonic Thixotropism of Gels. N. Marinenco. *Comptes Rendus*, 194. pp. 1824-1827, May 23, 1932.—Reference is made to the work of Loomis, Richards and Wood. In the present work a series of piezo-quartz plates are used capable of giving 927,000 to 139,000 $\sim$. The effect of these oscillations on sols and suspension is recorded by a microkinematograph. J. K.

3968. Vapour Pressure of Silica Gels. D. G. R. Bonnell. *Faraday Soc., Trans.* 28. pp. 463-471, May, 1932.—Determination of the moisture-sorption isotherms of dialysed and undialysed silica gels by a static method gives results which show that, after desorption, the succeeding isotherm is completely reversible in the case of the undialysed gels. A tentative explanation of this behaviour, based on Zsigmondy's theory of wetting and drying of dialysed silica gels, is advanced. The data obtained lead to the conclusion that the water taken up by the gel is in the uncombined state, and further evidence of the correctness of this view is furnished by experiments on the changes of volume occurring during early desiccation. T. H. P.

3969. Structural Changes of Cellulose Nitrate Films on Drying. J. J. Trillat. *Comptes Rendus*, 194. pp. 1922-1924, May 30, 1932.—X-ray examination of films prepared from an acetone solution of cellulose nitrate (12.9% N) and dried for periods of 0.25-100 hr., shows a crystalline structure, reverting gradually—after about 40 hr. drying—with contraction, to the structure of the original nitrate. This is due to an additive compound which gradually disappears as the solvent evaporates [see Abstracts 2966 (1930) and 1020 (1931)]. Ethyl acetate behaves similarly but not a mixture of ethyl and amyl acetates. Experiments with stretched films indicate that the contraction occurring on drying is

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in the direction perpendicular to the main valency chains. (Less highly nitrated nitrate shows progressively less crystalline structure. C. A. S.

3970. Heat of Sublimation of Carbon. W. E. Vaughan and G. B. Kistiakowsky. *Phys. Rev.* 40. pp. 457-462, May 1, 1932.—By using the most likely figures for the heat of dissociation of the C_2 molecule (5.5 and 7.0 volts), it is shown that in saturated carbon vapour at temperatures from 4150° to 4700° K. the partial pressures of both atoms and molecules are of the same order of magnitude. Statistical computations of the vapour pressure of solid carbon at these temperatures show that either the absolute vapour pressure as determined experimentally is entirely wrong or the pressure-temperature dependence is considerably in error. On the assumption that the absolute pressures are approximately correct, the heats of sublimation at 0° K. into atoms and into molecules are 161 and 176 cal. and 195 and 189 cal. respectively for the 5.5- and 7.0-volt dissociation energies. The true values probably lie within these limits.

3971. Measurement of Flame Velocities. A. Becker and K. Vogt. *Zeits. f. Physik*, 75. 11-12. pp. 804-808, May 6, 1932.—The method of the rotating mirror has been applied for the development of an accurate and completely reliable means of measuring flame velocities. Experimental details are given together with several examples. H. H. Ho.

3972. Influence of Powder-Temperature on the Variation of ρ_{dt} at Different Charging Densities. H. Muraour and G. Aunis. *Comptes Rendus*, 194. pp. 1927-1929, May 30, 1932.—Data are given and discussed for the combustion of powder fired at 18° and at 97° C. It is found that for the same period of combustion there is a constant difference of 10.7 kg./cm.²/sec. between the area ρ_{dt} from the curve at 18° and at 97° C., shown as a diminution in the case of the preliminary heated powder.

H. H. Ho.

3973. Combination of Carbon Monoxide and Oxygen under the Influence of Radon. S. C. Lind and C. Rosenblum. *Nat. Acad. Sci., Proc.* 18. pp. 374-386, May, 1932.—The purpose of this paper was to ascertain the extent to which CO_2 influences the rate of the α -ray reaction in which it is produced by the union of O_2 and CO . Only about 14.5 % of the ionisation falling upon CO_2 is found to be chemically effective. The recoil-atom effect R on the oxidation of CO was examined in a 1 cm. sphere, and the correction to be applied to velocity constants was found to be $1/(\alpha' + R)/\alpha'$, where α' is the sum of the partial pressures of reactants and the ionic equivalent pressure of the catalyst. The value of R found to be 62 mm. is in agreement with that predicted from the water synthesis. The inverse square of the diameter law was shown to hold for this oxidation by comparing the values of $(k\mu/\lambda)_{corr.} \div (\alpha' + R)/\alpha'^2 D^2$ in spheres of several sizes; an average value of about 126 was obtained. The M/N ratio (where M mol. of CO and O_2 are disappearing per N ion pairs produced in these gases by α -particles) for the reaction was calculated to be between 3 and 4.

H. H. Ho.

3974. Reaction of Gases with Incandescent Tantalum. Mary R. Andrews. *Am. Chem. Soc., J.* 54. pp. 1845-1854, May, 1932.—This paper records the behaviour of filaments of tantalum when heated in low pressures of nitrogen, hydrogen, oxygen or hydrocarbons. In nitrogen

absorption increases with increased pressure until about 100 volumes are absorbed, from which point the equilibrium pressure drops as absorption increases. Absorption can take place to the formation of TaN . In hydrogen, the amount absorbed depends on the concentration of atomic hydrogen in the gas, but in oxygen absorption is followed by oxide formation. In hydrocarbons, two carbides may be formed— Ta_6C_3 and TaC —which have both very high melting points and specific resistances of about 180×10^{-6} and 18×10^{-6} respectively.

H. H. Ho.

3975. Primary Photochemical Processes. Part I. Decomposition of Formaldehyde. R. G. W. Norrish and F. W. Kirkbride. *Chem. Soc., J.* pp. 1518-1530, May, 1932.—The photochemical decomposition of formaldehyde vapour takes place almost quantitatively according to the equation, $H_2CO = H_2 + CO$. The quantum efficiencies in the spectral regions 365-334, 313-303 and 265-254 $\mu\mu$ are 0.7, 1.1 and 0.9 respectively, and the predissociation limit lies at 280 $\mu\mu$. There is thus no evidence for a photochemical threshold associated with the predissociation limit. The balance of the evidence is regarded as against representation of the primary photochemical change as a splitting-off of a H atom, and evidence is furnished for the primary dissociation into H_2 and CO molecules: $h\nu + CH_2O = H_2 + CO$. This takes place spontaneously in the predissociation region, while in the region of fine structure it occurs as the result of a collision between an excited molecule and a second body, such collision effecting dissociation by redistribution of the energy of excitation.

T. H. P.

3976. Photochemical Decomposition of Ammonia. E. O. Wlig and G. B. Kistiakowsky. *Am. Chem. Soc., J.* 54. pp. 1806-1820, May, 1932.—It is pointed out that the mechanism of the apparently simple photochemical decomposition of ammonia by ultra-violet light is still far from settled. Reference is made to the work of Warburg, Kuhn, Kassel and Noyes, Bates and Taylor, and Koenig and Brings. It is now shown that the gaseous products of the photochemical decomposition of ammonia are a 1:3 nitrogen-hydrogen mixture even under conditions excluding a photochemical decomposition of hydrazine; that the quantum yield of ammonia decomposition at room-temperature is 0.25 independent of pressure, light intensity and time of illumination; and at 500° C. the quantum yield is 0.5 or more.

J. K.

3977. Potential of the Calomel Electrode. H. Riehm. *Zeits. f. phys. Chem.* 160. Abt. A. 1-2. pp. 1-7, May, 1932.—The potential of the calomel electrode, containing 0.1 N and saturated KCl, was measured at temperatures from 0° to 50° C. The observed values were corrected for liquid potentials due to the differences between the concentrations of the electrolyte. The results showed that the calomel electrode with saturated electrolyte was reproducible and stable, but it did not reach a constant value as rapidly as the electrode with 0.1 N solution. Formulae are derived for calculation of pH values when the calomel electrode is used instead of the hydrogen or quinhydrone electrode.

F. J. B.

3978. Behaviour of the Glass Electrode in Aqueous Solutions of Sodium and Barium Acetate. M. Dole. *J. Phys. Chem.* 36. pp. 1570-1573, May, 1932.—The glass electrode behaves in mixtures of sodium and barium as if no barium were present, which indicates that the barium ion does not affect the mobility of ions across the glass aqueous solution inter-

face due to any effect its double positive charge might have on the Helmholtz double layer. H. H. Ho.

3979. Hallwachs Effect in Divalent Elements. A. Pochettino. *Accad. Lincei, Atti*, 15. pp. 505-509, April 3, 1932.—The study of the Hallwachs effect in solutions of metallic salts presents various anomalies, especially in the chemical changes resulting from the action of the light. The largest effects are produced in potassium ferrocyanide, cuprous chloride, cuprous and cupric oxide and lead peroxide. The Hallwachs effect is greatest where an element of variable valency has one of its lower valencies. E. E. F. d'A.

3980. Becquerel Effect of Cuprous Oxide as Protective Layer Photoelectric Effect. F. Waibel. *Zeits. f. Physik*, 76. 3-4. pp. 281-282, May 31, 1932.—Both the protective photo-effect and the Becquerel effect are measurable only if the Cu_2O surface is previously provided with an electrical protecting layer (activation), which may be induced by an electric discharge or by polarisation in an aqueous solution. With an activated surface the Becquerel effect also appears spontaneously without an applied voltage. The photoelectric current is, with both effects, an electron current from the oxide through the protective layer. As regards both its course and its absolute magnitude, the spectral sensitiveness is the same for both effects; the quantum yield is up to 50 %, and the maximum lies between 470 and 500 $\text{m}\mu$. In general, the Becquerel effect shows a slight displacement towards the violet. Variations in the material, the conductivity of which varied from 200 to 10^7 ohm-cm., influence the two effects spectrally in the same way. The saturation currents are independent of the material, and the saturation voltages, with both effects, depend similarly on the conductivity. It is concluded that the Becquerel effect on Cu_2O is a protective layer effect. T. H. P.

3981. Quantum Mechanics of Electrochemistry. Part II. R. W. Gurney and R. H. Fowler. *Roy. Soc., Proc.* 136. pp. 378-396, May 2, 1932.—[See Abstract 1462 (1932).] Quantum mechanics is applied to the general question of the voltaic cell including electrode potentials, solution pressure, contact potential and chemical energy. In particular, it is shown that the heat evolved in an ordinarily conducted reaction, e.g., $\text{CuSO}_4 + \text{Zn}$, is determined by the Volta p.d. between the reacting metals. A general expression is deduced for the e.m.f. of a reversible cell, which is shown to obey the Gibbs-Helmholtz equation, and for the dependence of the interface potential (i.e., the actual p.d. at any metal liquid surface) on the concentration of the metal ions in solution. C. A. S.

3982. Electrolytic Dissociation in Organic Solvents. E. Vellinger. *Comptes Rendus*, 194. pp. 1820-1822, May 23, 1932.—Using calomel and antimony electrodes, the dissociation of more than thirty acids in a mixture of alcohol (1 part) and ether (3 parts) has been examined. The results confirm the earlier conclusion that the neutralisation curves thus obtained are analogous to those for aqueous solutions. Certain solvents, such as amyl alcohol, effect merely a displacement of the point of inflexion of the neutralisation curve in the sense of a diminution in activity, whereas others cause, in addition, a change in slope of the curve, this resulting probably from association of the acid molecules. Of the monobasic acids, picric acid and the mineral acids are the strongest in the alcohol-ether mixture. The dibasic acids give neutralisation curves which vary con-

siderably with the nature of the acid. With oxalic, malonic and propionic acids, the two carboxylic functions are scarcely discernible, only a slight discontinuity being evident. With maleic, tartaric, etc., acids, the two functions are very distinct, and the second part of the curve has a steeper slope. Other organic acids, such as phthalic, occupy an intermediate position. T. H. P.

3983. Mixtures of Electrolytes. Part I. Cryoscopy of the Mixtures. W. Sementschenko and E. Sawada. *Zeits. f. phys. Chem.* 159. *Abt. A.* 6. pp. 441-453, May, 1932.—The lowering of the freezing point in solutions containing a mixture of two or three electrolytes with a constant ionic strength in the solution of $\Gamma = \sum c_i \cdot z_i$ (c_i = molar concentration, z_i = valency of the ions) expressed in either volume- or thermodynamic (weight)-concentration, has been investigated. In the mixture $\text{NaCl} + \text{NH}_4\text{Cl}$ with a general (volume) concentration of 1.5 and 2 gm.-mol. per litre, the depressions remain practically constant. In the mixture $\text{NaCl} + \text{HCl}$ with the volume concentration 1.5 gm.-mol. per litre, the depressions and the osmotic coefficients, $\Delta T/\Delta T$, increase with the concentration of the H ions. In mixtures $\text{NaCl} + \text{NH}_4\text{Al}(\text{SO}_4)_2$ at $\Gamma = 4$, the depression increases as the concentration of NaCl increases. In the ternary mixtures $\text{NaCl} + \text{HCl} + \text{NH}_4\text{Cl}$ at $\Gamma = 4$ and $\Gamma = 6$ (thermodynamic concentration), the action of the individual properties of the H ions has the same character: the depressions and the osmotic coefficients rise with the concentration. All the solutions examined, except those of $\text{NaCl} + \text{NH}_4\text{Cl}$ mixtures, show at $\Gamma = 3$ marked divergence from additivity, the numerical values of the divergence being greatest for mixtures containing H ions. T. H. P.

3984. Theory of Concentrated Solutions. E. Wilke and W. Martin. *Zeits. f. phys. Chem.* 160. *Abt. A.* 1-2. pp. 39-44, May, 1932.—A series of measurements were made on the change of potential of the halogen electrodes with variation of concentration of the halogen acids. The results obtained on the bromine and iodine electrodes showed that the change of ionic radius of the ions of the halogen acids with the concentration was confirmed. [See Abstract 2722 (1926).] F. J. B.

3985. Unhydrated Solute Element Ions. L. H. Flint. *Washington Acad. Sci.*, J. 22. pp. 233-237, May 4, 1932.—The theory previously proposed [see Abstract 3074 (1932)] substantiates the view that the H ion is not hydrated, and the same appears to be true of the Rb and Cs ions in solutions of rubidium and caesium chlorides, and of the Br and I ions in solutions of KBr and KI. Nevertheless, in solutions of CdBr_2 and CdI_2 all the ions are hydrated, and since according to the theory proposed the velocity of an ion is determined by the degree of hydration, Kohlrausch's law of the independent migration of ions does not appear to be valid. H. F. G.

3986. Conductance of Sodium Oleate Solutions in Relation to Interfacial Adsorption. R. F. Nickerson and P. Serex. *J. Phys. Chem.* 36. pp. 1585-1593, May, 1932.—At concentration 0.002 N, sodium oleate shows an abrupt change in the trend of the concentration-conductivity relationship, which is coincident with minimum surface tension and loss of frothing power. Surface tension of sodium oleate solutions varies inversely with hydrolysis between the limiting concentrations

0.059 N and 0.002 N. More "acid sodium oleate" is adsorbed at the oil/solution interface than at the vapour/solution interface of the same sodium oleate solution. Various oils (hexane, heptane, benzene, toluene, m-xylene) have differing capacities to adsorb "acid sodium oleate." The mechanism of the buffer action of sodium oleate in solution has been demonstrated. It is pointed out that the rôle of acid sodium oleate in emulsification has been much underrated. Frothing is attributed to a hydrolytic system in equilibrium with a saturated surface and an excess, colloidal, or colloidal and crystalloidal, depending on the concentration.

H. H. Ho.

3987. Conductivity of Electrolytes in Ethyl Cyanoacetate and in o-Toluenitrile. J. C. Philip and P. Rangaramanujam. *Chem. Soc., J.* pp. 1512-1518, May, 1932.—Results are given of determinations of the conductivities of a number of salts in these two solvents at 25° C. In all cases the equivalent conductivity is a linear function of the square root of the concentration. For the tetra-alkylammonium iodides in ethyl cyanoacetate the slope of this line is only slightly greater than that required by the Onsager equation, but for other salts in this solvent and for all the salts in o-toluenitrile the observed slope is definitely and sometimes much greater than the calculated slope. The data now available for four nitrile solvents suggests that departure from the behaviour postulated by the Onsager equation is exhibited more definitely in aromatic than in aliphatic solvents.

T. H. P.

3988. Density, Conductivity and Internal Friction of Salts of Low Melting Point. P. Walden and E. J. Birr. *Zeits. f. phys. Chem.* 160. *Abt. A.* 1-2. pp. 45-68, May, 1932.—The densities, electrical conductivities, and viscosities of 6 alkylated ammonium picrates and of naphthalene, picric acid, and naphthalene picrate, in the liquid state, are recorded. The molecular volumes and the coefficients of expansion of the slightly dissociated picrates of primary, secondary and tertiary amines are greater than those of the quaternary ammonium bases, whilst the product of the coefficient of expansion and the absolute melting point is greater for the slightly dissociated liquids than for the completely dissociated quaternary salts. The relationship between conductivity and viscosity on the one hand and molecular weight and degree of substitution on the other is discussed. The viscosity of iso-derivatives is much greater than that of the corresponding n-derivatives, a result contrary to that usually observed. Data are recorded for molten tri- and tetra-alkylated ammonium iodides and perchlorates. Comparison of the results with those described above indicates that the molecular condition in the liquid is governed primarily by the degree of substitution of the kation. The temperature coefficients of the surface tension and the viscosities of molten mono- and di-substituted ammonium salts indicate that in these compounds association occurs. [See following Abstract.]

H. F. G.

3989. Density, Conductivity and Internal Friction of Mixtures of Salts of Low Melting Point. P. Walden and E. J. Birr. *Zeits. f. phys. Chem.* 160. *Abt. A.* 3-4. pp. 161-193, June, 1932.—The densities, electrical conductivities and viscosities of eight binary mixtures, in various proportions, of a number of substituted ammonium picrates (in two cases with picric acid) have been determined at temperatures between 75° and 150° C. All three properties are additive for mixtures of tetra-alkylated

ammonium picrates, although the observed molecular volumes are smaller than the calculated values; the product of conductivity λ and viscosity η is also additive, and the degree of dissociation of these completely dissociated salts is thus not altered on mixing. The same is true of mixtures of the tetra- with the slightly dissociated tri-substituted salts, but with mixtures of tetra- with mono- and di-alkylated salts the values of $\lambda\eta$ indicate that the dissociation of the weaker salt decreases on mixing; it is shown also that the decrease of the viscosity of such mixtures is proportional to the alteration of the degree of dissociation. The mono- and di-substituted ammonium ions in the melt, as in solutions in ordinary solvents, are thus surrounded by a shell of undissociated molecules. A diminution of the degree of dissociation of, probably, both components takes place in mixtures of two feebly dissociated salts. [See also Abstract 2199 (1932) and preceding Abstract.] H. F. G.

3990. Influence of Voltage on the Conductivity of Strong and Weak Acids. J. Schiele. *Ann. d. Physik*, 13. 7. pp. 811-830, June 2, 1932.—The method of Wien and Malsch for measuring the voltage effect has been improved so that very small changes of conductivity may be measured, the error being about 0.03 %. In accordance with theory, the effect is very small with strong acids (di- and tri-chloroacetic), but with weak acids such as acetic and propionic it is very much greater. The results cannot be interpreted fully with the aid of the Debye-Onsager theory. The action of strong fields in producing dissociation of the molecules of the solute is discussed. H. F. G.

3991. Electrocapillary Effect of Capillary-Active Organic Molecules. A. W. Davis. *Phil. Mag.* 13. pp. 1188-1192, June, 1932.—The electrocapillary curve of the solution of a capillary-active electrolyte is approximately parabolic. If to such a solution be added a capillary-active non-electrolyte, e.g., one of the alcohols, the modified curve is found to be depressed in the region of the maximum and appears to be a truncated replica of the primary curve. If, however, the electrolyte in the primary solution yields an active ion on dissociation, then one branch of the curve is shifted over its entire length and the maximum with it. In the present work the effect of this active ion upon the adsorption of active organic molecules in a mixed solution has been investigated. The modifying effects of the active organic molecules are similar whether the primary solute is an active or inactive electrolyte, except that the active ions determine the form of that branch of the curve corresponding to their normal adsorption, a result in accord with that of previous workers on the effect of capillary-active electrolytes on the adsorption curves of solutions containing surface-active substances and of mixtures of surface-active salts and non-ionised molecules. H. H. Ho.

3992. Absolute Value of Diffusion Currents in Moving Electrolytes. A. Eucken. *Zeits. f. Elektrochem.* 38. pp. 341-345, June, 1932.—The theory of diffusion currents is examined theoretically and a series of determinations of the absolute value of the diffusion currents in moving electrolytes carried out. An apparatus is designed in which the flowing of the electrolyte is laminar and the velocity linear. The vessel consists of two parts, one of which remains stationary, the other revolves, and the distance between the two portions can be varied within certain limits. An auxiliary electrode of thick platinum wire is employed for the measure-

ments. The results show that arrangement permits the measurement of the absolute value of the diffusion current with an accuracy of 10 %.

F. J. B.

3993. Cataphoresis of Colloidal Carbon Solutions. H. Lachs and Karolina Gestel. *Kolloid Zeits.* 59, pp. 170-179, May, 1932.—The conditions are determined for producing stable and reproducible colloidal carbon solutions. Ultrafiltration and repeated solution are employed. The cataphoretic velocity of the colloidal carbon solutions is determined by the modified Burton method. The colloidal solutions are used in the pure condition and in the presence of such electrolytes as KCl, $K_4Fe(CN)_6$ and KOH.

J. K.

3994. Electrolytic Water-Transport and Ionic Transport Numbers. H. C. Hepburn. *Phys. Soc., Proc.* 44, pp. 267-273, May 1, 1932.—This paper gives the results of determinations of the electrolytic water-transport per faraday in the case of copper sulphate solutions of concentrations ranging from 1.0 N to 1.8 N. The parchment diaphragm method has been employed; and difficulties experienced owing to the effect of diaphragm-polarisation have been surmounted by adopting a special experimental procedure. The electrolytic water-transport per faraday remains constant with increasing concentration of copper sulphate up to normal, as the author has shown in a former paper, but it decreases regularly with further increase in concentration. The probable factors contributing to this decrease are considered. The sequence in the values of the electrolytic water-transport per faraday corresponds with that in the values of the slope of the curve connecting the Hittorf transport number with the electrolyte concentration, but the corresponding values are not in numerical agreement as required by an expression proposed by Riesenfeld and Reinhold. This discrepancy is investigated by means of a more accurate expression derived by the author. The determinations of the electrolytic water-transport are employed to correct the values of the experimental Hittorf transport number. [See Abstract 655 (1932).]

AUTHOR.

3995. Hydrogen Overvoltage. A. Frumkin. *Zeits. f. phys. Chem.* 160, Abt. A, 1-2, pp. 116-118, May, 1932.—It is shown theoretically that the law relating hydrogen overvoltage with current and the relationship between the catalytic activity and affinity constants of weak acids and bases are based upon the same fundamental considerations. H. F. G.

3996. Alternative Electrode Reactions. Part I. Reactions at Platinum Electrodes in Nitric Acid Solutions. H. J. T. Ellingham. *Chem. Soc., J.* pp. 1565-1579, May, 1932.—When a nitric acid solution is electrolysed between platinum electrodes the predominant reaction at the kathode may be either (a) reduction of the acid to nitrous acid which may be decomposed to nitric oxide, or (b) evolution of hydrogen. The kathode potential and current density have been measured during a step-wise increase (and decrease) of voltage, and the former also at successive times with constant current density. Whether (a) or (b) predominates depends on the conditions of electrolysis, (b) occurring only when (a) cannot proceed rapidly enough to remove hydrogen as fast as it is produced. The velocity of (a) is very low even for fairly concentrated nitric acid, but it is strongly autocatalytic, so that the current density it can maintain is determined by the concentration of nitrous acid at the kathode.

C. A. S.